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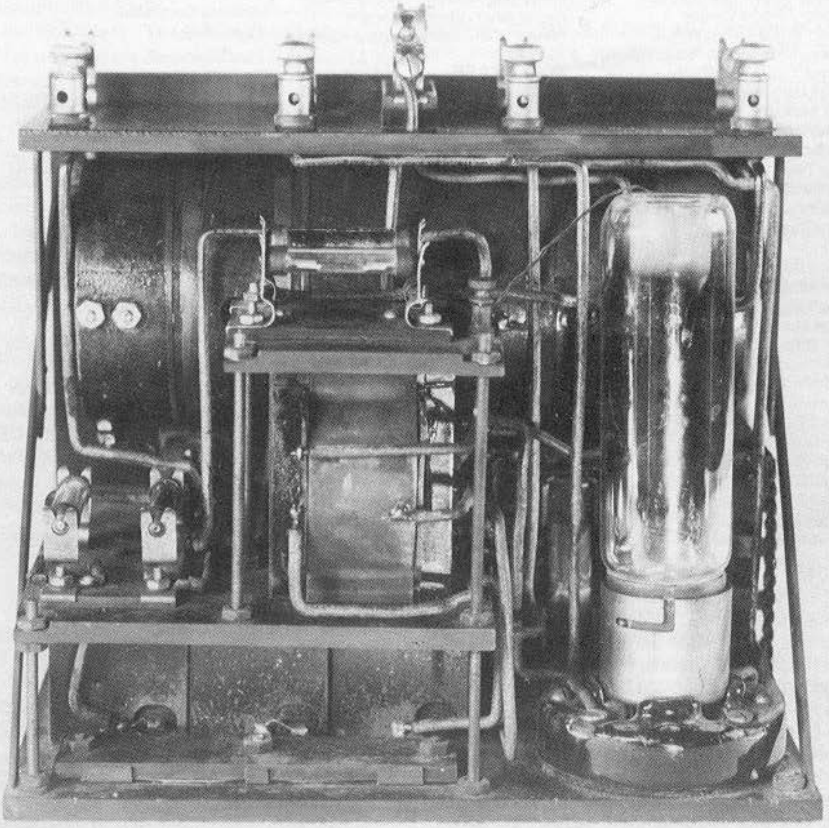

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The "Old Timer's Bulletin": The AWA Journal

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AWA NETS (EST)

SSB:
Sun. 7247 kHz at noon (NCS: N4FS)
3837 kHz at 5 PM (NCS: W2ICE)
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Mon.-Wed.-Fri. 3837 kHz at 9:30 AM (NCS: W2ICE)
CW:
7050 kHz (NCS: varies)
Daily at 4 PM; first Wed. of each month at 8 PM

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FROM THE EDITOR

Wireless technology started out without vacuum tubes, but de Forest's little triode certainly helped matters along. It and its descendants soon displaced all manner of mineral detectors, spark transmitters, arc RF sources, and even rotating machines like the Alexanderson alternator.

Collecting tubes is, of course, an honored theme of our history-hobby. So this issue focuses on the vacuum/electron tube. Early collectors amassed whole walls of Audions, Fleming valves, Welsh peanut tubes, Weagant valves, brass-base tipped delights, etc. A later generation is out probing flea markets for Forties transmitting tubes, small klystrons, disc-seal UHF-SHF tubes, foreign specialties, and anything with "Western Electric" on it. Whatever the interest, the material is still out there.

So this OTB offers a group of "tube" material; even the Museum page features samples of the Crosley Deflectron, a gridless triode apparently related to the Goddard tube, to the Negatron devised in England by John Scott-Taggart, and to the Huth tube invented in Germany.

Three reference listings of tubes in this issue, on pages 11, 20, and 29, rely heavily on source material supplied variously by Bro. Pat Dowd, W2GK; Attila Balaton; and Bill Smith, N9TT. Smith points out that one of the primary reference sources used, the Armed Forces Cross Index of Electron Tubes, is still available. Fair Sales (419-223-2196) lists it on page 23 of their 1990 catalog for $12.50.

THE PUBLICATIONS INDEX: STILL IN STOCK

The 28-page, 30-year index of AWA publications remains available. Besides the OTB, it lists articles in the AWA Review and cites the stand-alone monographs produced in 1978-82. The price is right (zero): send a self-addressed letter envelope with 65 cents' postage (or an 8-½ X 11" envelope with 85 cents') to your editor at 44 E. Main St., Flemington, NJ 08822.

BULLETIN MECHANICS

We take proposed articles on paper, hopefully double-spaced, as always. However, a growing number of AWA writers do word processing on personal computers. For longer items in particular, we welcome stories on disk, either unformatted ("ASCII," "generic") or formatted via Microsoft Word. We can readily take 5-inch *IBM/DOS-compatible* discs in the usual styles: double-sided double-density (DSDD, 360K), the newer double-sided high-density (DSHD, 1.2 meg) and the old 160K formats. Without major stress, we can also use 3-½" discs. This gets long items into the OTB or Review much sooner and a lot more accurately than retyping by hand.

We also get requests from other bulletins for approval to reprint OTB articles from time to time. Since each article is retained on disc after publication, we can supply story texts on-disc for composing electronically, or can reprint the material in a variety of fonts to fit a particular page specification.

AWA REVIEW, VOL. 6?

Now that Vol. 5 is out (see p. 5), it's time for you beginning or experienced authors to think about topics for Vol. 6 of the AWA Review. More details in the February OTB.

THE COVER

An experimental regenerative receiver using a kenopliotron tube. A *what?* See page 7!

CALENDAR

October 17-18 - AWA 1929 QSO Party
October 18-20 - "Friends of Old Time Radio" Convention, Newark
October 19-21 - VRPS-AWA Convention '90, Dallas, TX
December 8 - AWA Florida meet, Bradenton

"FRIENDS OF OLD TIME RADIO" CONVENTION

Thursday-Saturday, Oct. 18-20

The 15th annual "Friends of Old Time Radio" convention will take place at the Holiday Inn - North, Newark, NJ, with a "Salute to CBS Radio." The preliminary schedule calls for informal time and a dinner on Thursday. Friday is to include a discussion of the Lux Radio Theater, appearances by Raymond Edward Johnson, the Dave Warren Players, a presentation on sound effects by Barney Beck, a visit with Ray Erlenborn, and a session on Comics and Radio by Jack French. The evening banquet will feature a recreation of the Lux Radio theater with Margot Stevenson. On Saturday the events planned are a session on early drama on CBS by Anthony Tollin, a "Gunsmoke" panel with Gabor and SuzAnne Barabas and Parley Baer, a Mercury Theater panel with Richard Wilson and Arthur Anderson, a session on "Dick Tracy on Radio" with Sidney Slon and Bill Nadel, and a recreation of a Gunsmoke or Mercury Theater show. The Saturday dinner will include an Amos 'n Andy recreation by the Dave Warren Players, a tribute to CBS, and a second recreation. The dealers' room will be open Friday and Saturday.

For further information, contact Jay Hickerson, Box 4321, Hamden, CT 06514, 203-248-2887; or Anthony Tollin, 201-575-6849.

Behind the scenes at AWA: ladies of the Breesport United Methodist Church preparing OTBs for mailing.
[Photo: Joyce Peckham].

VRPS-AWA CONVENTION '90

Friday-Sunday, October 19-21

The Vintage Radio and Phonograph Society - AWA Convention '90 will be held in Dallas, TX. Based on last year's successful trial, the convention will include auctions on both Friday and Saturday and added activities on Friday.

Three technical programs will be presented Friday afternoon, followed by an evening auction. Saturday's program includes the Old Equipment Contest, the second auction, and the Awards Banquet with entertainment. The customary flea market, inside and weatherproof, will occur on Sunday morning.

To encourage advance registration, VRPS is offering two very fine prizes: a cathedral radio and an early phonograph. Members who register in advance, and *only* advance registrants, will receive chances for the drawing for these prizes.

For a registration card, program, map, etc., contact the registration chairman: Don Nordenholt, 1509 Cliffbrook Drive, Plano, TX 75075.

FLORIDA MEET - BRADENTON

Saturday, December 8

Meet, flea market, ladies' activities, starting at 8:00 AM, at Stewart Elementary School, 7905 15th Ave., N. W., Bradenton. For more details, send an SASE or phone: Norm Smith, 7203 17th Ave., N. W., Bradenton, FL 34209, 813-792-0003.

MEETING REPORT: MARC EXTRAVAGANZA '90

"Extravaganza '90," the Michigan Antique Radio Club's annual convention in July, was a tremendous success, with over 400 people registering from 15 states (AZ, CA, CO, FL, IA, IL, IN, MC, MD, MN, MO, NY, OH, PA, and WI), plus Canada and Japan. In addition to a world-class Sparton exhibit, an active flea market, a silent auction, three 50/50 raffles, and a donation auction, we had over 225 items sold off by auctioneer Steve Waldron. We would like to thank the AWA for co-sponsoring this event and look forward to a

successful "Extravaganza '91." [Jim Clark, MARC president]

REPORT: NFWA-AWA SUMMER MEET

This event, on August 25, drew 60 participants from as far away as Dayton. In the equipment contest, the Best of Show (Ken Conrad) award went to J. J. Powell for his display of nicely restored Silvertone battery sets, in line with the special theme of sets made by one firm and marketed by another. Some goodies turned up in the flea market, among them a WW II spy transmitter-receiver and a Westinghouse RA unit (of the RA-DA combination) bearing serial number 189, probably from the first month's production. A vanload of AWA Museum surplus found new owners via an auction conducted by Bruce Roloson, thereby supporting funding of the Museum. An unusual wurlitzer cathedral drew $300. Bruce then conducted a novel walking auction of attenders' goods, simply moving from one flea-market position to the next. [Information from Jim Kreuzer]

SILENT KEYS

John J. Nagle, K4KJ. Well-known collector of National receivers, speaker at AWA events on prewar amateur and commercial communications equipment, and author in the OTB, CQ, and other publications. Born 1925; died of multiple myeloma, a form of bone cancer. First licensed at 15. AWA member for 20 years; senior member of the IEEE; licensed professional engineer, member of the Audio Engineering Society. Retired in May, he had been employed as an electrical engineer by Page Communications Engineers, NOAA, the Defense Communications Agency, and most recently the Army's Warrenton Training Center. The AWA community extends its condolences to Martha Nagle. (Thanks to Martha Nagle and Ted Hannah, K3CL, for source material.)

Reo de Pew, WD5HLZ, originally of WGN; retired electrical engineer at the Sandia National laboratories, long-time participant in the AWA Net and QCWA. (Information from Chuck Brelsford, Bruce Kelley, and Robert Baird).

Art Oldendorf (per Jack Nelson, W2FW).

AWA REVIEW, VOL. 5, NOW AVAILABLE

This year's issue of the AWA Review presents a variety of material of historical value in 192 pages and 83 illustrations.

Following-up on his narrative of tube development in Vol. 4, John Anderson provides a study of radio development and production activities at GE. His time period is the years before RCA went into manufacturing, preceding the division of design talent and other resources between RCA and GE's own operations.

Two papers deal with signals intelligence and countermeasures. Bart Lee narrates the WW I vintage story of Charles Apgar uncovering the disguised signals of WSL at Sayville, LI, and the actions of American radio intelligence on the Mexican border. George Sterling, head of the FCC's Radio Intelligence Division during WW II, details the actions of his group in shutting down illicit stations, both inside and outside the U. S.

Two items address vacuum-tube history. Thomas Briggs' exposition of the life of Robert von Lieben and the LRS Relay gives the history of an electronic amplifier patented well *before* the de Forest Audion. Attila Balaton explains a wide variety of construction details unique to Western Electric tubes, coverage of ongoing use to tube collectors in judging the manufacturing dates and general history of these collectibles.

A lively item of broadcast history is included. John Schneider describes the brief life of San Francisco as a major originating point for network radio programming (1927-37), based on extensive interviews with pioneer network employees. He covers the NBC Orange Network, the Don Lee Network, and the arrival of CBS and MBS on the West Coast.

Finally, a unique contribution appears: David Kraeuter's tabulation of the 1090 (!) U. S. patents of ten major electronics inventors. Expanding greatly on an earlier publication of the Pittsburgh Antique Radio Society, he lists work of some prodigious inventors: Edwin Armstrong, Frank Conrad, Lee de Forest, Allen DuMont, Philo Farnsworth, Reginald Fessenden, John Fleming, A. Atwater Kent, Guglielmo Marconi, and Vladimir Zworykin. Some of those patents were basic technology; most are long forgotten. The broad creative powers of their holders are visible in both the patents' sheer numbers and their subjects: many were wholly unrelated to electronics. (Conrad patented a hand grenade; de Forest patented, of all things, a *transistor*.) The listing of Major Armstrong's inventions is of particular interest in 1990, the 100th anniversary of his birth.

Volumes 3 and 4 are also available. Vol. 4, 156 pp., offers: "A Sketch of Early Radio Vacuum-Tube Research and Development at the General Electric Company" (John Anderson), "The HRO Report: Dating the Early HRO" (Charles Fisher), "Tube Manufacturing at Western Electric: The WE 300B" (Attila Balaton), "The Feminine Touch in Telecommunications" (Louise Moreau), "A Decade of Electroacoustic Reproduction (1920-1930)" (Floyd Paul), "An Elusive Frame of Television History Preserved" (William Denk), "Western Electric Tubes: Some Interesting and Historic Types" (Ludwell Sibley), and "Early Microphone History" (Bob Paquette).

Vol. 3, 136 pp., contains: "Atwater Kent Radio Development, Part III - The AC-Powered Receivers" (Ralph Williams), "Program Transmission and the Early Radio Networks" (Ludwell Sibley), "Audio-Frequency Characteristics in Early Broadcasting" (Robert Morris), "AC Supply for Radio Receivers - How the Lowell and Dunmore Patents (Almost) Changed the Industry" (Alan Douglas), "The Radio Apparatus of Ernest C. Mignon" (Lauren Peckham), "Foreign and Military Telegraph Keys" (Louise Moreau and Murray Willer), and "The Alexanderson System for Electromechanical Production of Radio-Frequency Energy" (Glen Fuller).

To order, make a check out to AWA and mail to: Dexter Deeley, 8 Briar Circle, Rochester, NY 14618. Vol. 5 or Vol. 4, $10.50; Vol. 3, $9.50 postpaid in the U. S. and Canada (add $4.00 for overseas air mail.)

BACK ISSUES

The following issues of the Old Timer's Bulletin are orderable via Dexter Deeley. All prices are postpaid, $2.50 each except as noted.

Volume and Number

Vols. 22, 23, 26, 28, 29, 30: all four numbers.

1-2@	1-3@	14-1	14-4	15-4	17-1
18-3	19-3*	19-4	20-1#	20-2	20-3
20-4%	21-1	21-2	24-1	24-3	24-4
25-1	25-3	25-4	27-1	27-2	27-3
31-1	31-2				

@ 1-2 and 1-3, reprints for reference, $0.50 each.

* 19-3 includes Elliott Sivowitch's 20-page mono-graph "A Technological Survey of Broadcasting's 'Pre-History,' 1876-1920," $4.00.

20-1 includes Thorn Mayes' 13-page monograph "The Federal Telegraph Co., 1909-1920," $4.00.

% 20-4 includes Leland Anderson's nine-page monograph "Priority in the Invention of Radio: Tesla vs. Marconi," $4.00.

Index to Vols. 18-29 and Review Vols. 1-3, free with purchase.

AWA LIBRARY SCHEDULE

The AWA Library in the Annex will be open to members from 2:30 to 5:00 PM on Sunday, October 14, the last opportunity of this season. Admittance can be gotten by going to the Museum.

BULLETIN DEADLINES

If you plan to submit material for publication, please adhere to the following dates for the February issue: general material and meeting notices, December 1; want ads, December 7.

ITALIAN CLUB FORMED

The "Associazone Italiana Radio d'Epoca" (AIRE) was legally founded on June 9. The president, Fausto Casi, says its scope and interests are equal to those of other vintage-radio clubs around the world, i. e., telecommunications, with particular interest in radio, telephone, telegraph, and other aspects of early electricity.

Italian residents can apply for membership through AIRE, Via Cavour 5, Arezzo, Italy. A subscription which will last until December 1991 will cost Lit. 50,000.00=. Overseas membership is Lit. 55,000.00=. The first newsletter is expected out this Fall. More information is available through either the AIRE headquarters in Arezzo or a query here at my home. [R. Kron, Via Macchiavelli 12/A, 36061 Bassano, Italy]

ANTIQUE RADIO COLLECTORS OF OHIO

This new club, centered in Dayton, meets monthly in Kettering, plans to have meets, and publishes the quarterly ARCO "Code." Dues: $10 per year. Contact: Karl Koogle, 2929 Hazelwood Ave., Dayton, OH 45419.

HRSA CONTACT

Garfield Wells, secretary of the Historical Radio Society of Australia, has offered to serve as a contact for North American collectors. Membership in the HRSA is open to U. S. and Canadian collectors. He reports there is considerable interest locally in collecting AK, RCA, and other early American sets, in swapping Thirties Australian sets for U. S. receivers, and in corresponding generally. His address: P. O. Box 428, North Sydney 2059, N. S. W., Australia.

DON C. WALLACE, W6AM

This is the title of an upcoming book, the history of amateur radio as experienced by Don Wallace, famous DXer. By Jan D. Perkins, N6AW. Hardbound, 350 pages, prepublication price $19.95, from Wallace & Wallace, 11823 Slauson Ave., Suite 38, Santa Fe Springs, CA 90670. We'll have a review in the OTB as soon as it's available.

RECENT AWARDS

The Radio Club of America has awarded **Bob Morris, W2LV**, its Poppele Award for outstanding contributions to the improvement of radio broadcasting and its Ralph Batcher Award to **Bro. Patrick Dowd, W2GK**, for preserving and documenting historical radio tubes. Advancements to the grade of Fellow have been awarded to **Morris, Alan Douglas,** and **Gilbert Houck.** The QCWA President's Award has gone to **Bruce Kelley, W2ICE**, for contributions to amateur radio. Our congratulations. . .

AWA MAGAZINE-BOOK SALE

As with last year's sale, the Museum de-accession committee has selected a collection of surplus magazines and catalogs, which are offered to the membership on a bid basis. Material included QSTs dating as early as 1916, radio magazines of the 1920s, and early books including a Marconi Yearbook. Write the AWA treasurer for a listing: Dex Deeley, 8 Briar Circle, Rochester, NY 14618. [BK]

ANTIQUE ELECTRONIC SUPPLY MOVES

This well known parts source is now at 6221 S. Maple Ave., Tempe, AZ 85283. New phone: 602-820-5411; fax, 602-820-4643.

AWA OLD-TIME CW CONTEST

The annual OT CW Contest is scheduled for late February. Details in the next issue.

EARLY EQUIPMENT PROFILE

EDITED BY
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All correspondence requires SASE for reply

ALBERT W. HULL'S KENOPLIOTRON: BORN TOO SOON?

My interest in the work of A. W. Hull (1880-1966) began some years ago when I obtained several samples of his early magnetrons. He presented a paper before the American Institute of Electrical Engineers which was published in its Journal for September 1921. Included are some excellent historical background and predictions of possible applications for the magnetron. At the time, the device was being tried as a "synchronous detector" in CW radio telegraphy for transoceanic receiving stations at RCA.

Hull joined the staff at General Electric in 1913 and by 1916 had developed the dynatron which used a magnetic field to control electronic emission. (This was a distant forebear of the tetrode dynatron oscillator popular in the early Thirties.) A later variant, the pliodynatron, controlled electron flow with a magnetic field or a more conventional grid. A good explanation of the theory of operation for these devices was given in a lecture presented to the Institute of Radio Engineers by A. W. Hull on March 1, 1922 (IRE Proceedings, October 1922).

The GE Company came up with a variety of interesting names for vacuum tubes. "Magnetron," complained Lee de Forest, is a "Greco-Schenectady" name for a vacuum electric device controlled by a magnetic field! But what of the "Kenopliotron"? Kenotron, according to Greek scholars, is "a thing with nothing in it." GE applied this term to rectifiers for many years. Pliotron, according to Hull's September 1921 paper, is intended to name "a thing that amplifies."

These two functions were combined into one envelope and described in a paper presented by Hull before the IRE on November 1, 1922 (IRE Proceedings, April 1923). His topic was "A Combined Kenotron Rectifier and Pliotron Receiver Capable of Operation By Alternating Current Power." Although no actual receiver is shown, Hull illustrated the idea with schematics shown in Figures 1 and 2. The special tube, made at the research laboratory of the GE Company in Schenectady, is illustrated in his Figure 3.

Hull described the tube as having a voltage amplification about four times that of the UV-201 at both audio and radio frequencies. The filament is tungsten, drawing two amperes of AC at five volts and heated to approximately 2300 degrees K. This temperature provides ample electrons for functioning as a kenotron rectifier. The surrounding cathode provides a source of emission for the pliotron portion of the tube. The cathode sleeve was 1-1/8" long, coated with barium oxide.

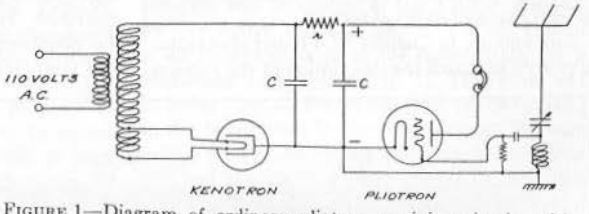


FIGURE 1—Diagram of ordinary pliotron receiving circuit, with kenotron rectifier supplying plate voltage

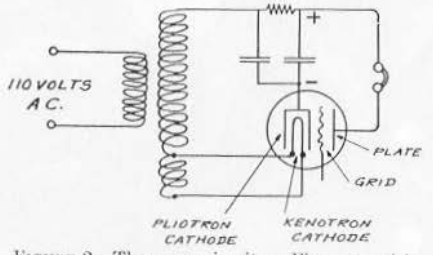


FIGURE 2—The same circuit as Figure 1, with kenotron incorporated in the pliotron

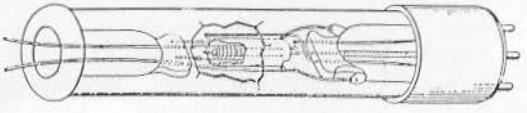


FIGURE 3—Drawing of a laboratory model of new tube

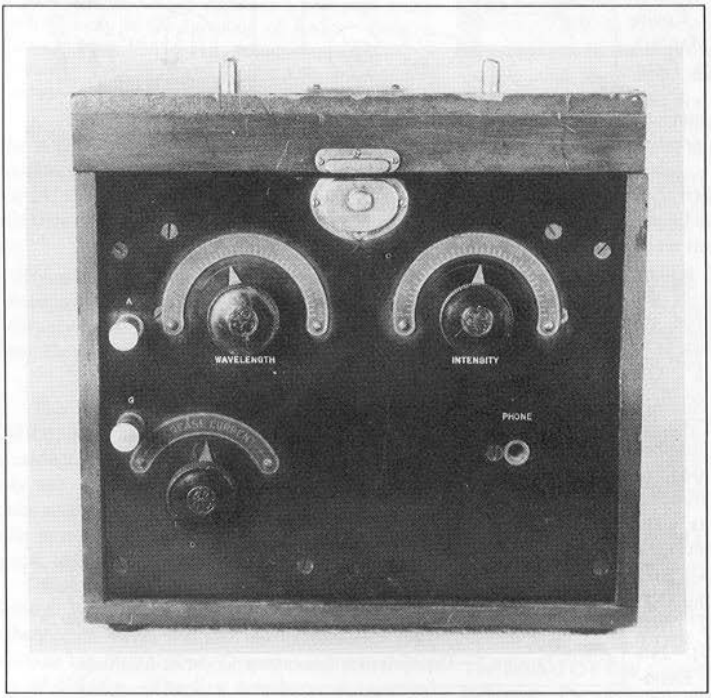
What happened to Hull's idea where one tube would act as both rectifier and detector? I had seen no reference to such a system and no receiver using this novel idea had appeared in a museum or private collection. The almost unbelievable answer came via a telephone message in December of 1989. The caller had in his possession an odd one-tube receiver and asked for my help in identification. His description made little sense, as this set had the appearance of an early battery-operated receiver, but a power supply had been installed for AC operation. I assumed someone had made up the receiver from spare parts, but decided to ask for additional details. As we talked, I made a sketch of the front-panel layout. The call was concluded and as I studied the drawing, there was something faintly familiar about it. Somewhere in my files there was a photo of a similar receiver, but where?

For several hours I searched my library and finally began working my way through William C. White's "Early History of Electronics in the General Electric Company." This rare material is contained in 12 volumes. It was completed in 1955 after three years of work. Included are dozens of beautiful factory photos showing test benches and prototype equipment designed and built at the research laboratory. These are accompanied by several hundred pages of text.

Sure enough, in Chapter VI, I found photos that appeared to match the description of the receiver discussed during the phone call earlier that evening! The caption by White stated "Single Tube Radio Receiving Set Using AC Power For Plate And Filament, Assembled By E. F. Hennelly At The GE Research Laboratory In Schenectady 5-25-23." The photos in this column were taken shortly after I brought the mystery receiver home. I wondered how many of these sets were made up, assuming several would be necessary to produce accurate field test data.

Later, after examining the set along with the photos in White's GE history series, I realized that every screw, wire and binding post was aligned *exactly* as pictured in 1923! Hull and Hennelly's prototype AC-operated receiver had survived for 67 years. At one point this same set had been placed at the side of a road, but was rescued just before the garbage truck arrived. The cabinet is well made and is similar in style and hardware to the 1917 GE transmitter, type CG-1104A. The circuit is regenerative; the variocoupler and variometer coils appear to be identical with those used in the Radiola II receiver. Fortunately the rare kenopliotron tube is intact; it is the only sample I know of.

It is interesting to note that the only mention of the term "kenopliotron" appears in White's notes where the development of the UY-227 AC tube is described. He states: "In July, 1925, samples of the double-ended type of heater tube together with samples of Dr. Hull's Kenopliotron were submitted to RCA. By October it was pretty well established that radio sets within the next few years would have five or more tubes so that the Kenopliotron would not seem as applicable as the double-ended style." The double-ended type being discussed by White was an early experimental tube designed by Westinghouse, the UX-225.



Perhaps some day I'll learn how the kenopliotron receiver left the GE research lab and ended up near the shores of Lake Ontario. Meanwhile, we all owe a great deal to those who saved this historical item for future generations!

HOW DID DE FOREST INVENT THE GRID AUDION?

Lloyd Espenschied

This is another item written by Lloyd Espenschied but not published before his death in 1986. A shorter version appeared in the OTB in 1963, but the author added considerably to it to produce this version.

In the winter of 1906-7, Dr. Lee de Forest inserted a third element, an intervening grid, into the thermionic diode. This control electrode proved to be such a revolutionary contribution that one may wonder how managed to do it.

This question was raised in the OTB for the Fall of 1962 (Vol. 3, No. 3) in an intriguing sketch by George Applegate on "An Adventure in Book Collecting." In foraging for old radio books, George found an original 1906 edition of J. A. Fleming's famous The Principles of Electric Wave Telegraphy, a copy that had been owned by de Forest's old assistant C. D. Babcock.

"Babs," as de Forest called him, had made in it many interesting notations, among them on page 398, the reminder to "look up" the Zehnder Trigger Tube described there. George recognized the Zehnder tube to have been "the first device to use internal electrodes, positioned between the cathode and the anode, for the purpose of triggering an external source of power by means of received signals." (Incidentally, this at once disposes of de Forest's claim to having invented the "B" or anode battery.)

The question is raised as to whether Babs did look up for Lee the original Zehnder paper, which had been published in Wiedemann's "Annalen der Physik" in 1892. He would not have had to look far, for it appeared in English that same year in The Electrician (London, Dec. 30, 1892, p. 253).

It is well known that de Forest followed the German technical literature closely, and this is quite in line. Turning to the Zehnder article, one finds he used a cold-cathode Geissler tube, which was a relay kind of detector rather than an amplifier, and that he observed a vital point: he placed his third electrode (a minute glow-discharge gap in itself) "near the cathode since it is known that in the neighborhood of this lies the greatest resistance of the air [gas] path."

The present writer had known Dr. de Forest since the spring of 1907 and exchanged many communications with him, but never was it possible to obtain from him a description of how he managed to come upon the grid control element. His assistant early in 1907, the late John V. L. Hogan, told the writer that de Forest was experimenting with a Fleming valve, trying all manner of ways of influencing it with radio signals. Starting with outside electrodes, he gradually felt his way to the intervening "hairpin."

The figures in de Forest's patents support this viewpoint. In his AIEE paper on "The Audion" describing the two-element tube (Oct. 1906), there is indication of his seeking to employ an additional electrode for control, as yet outside.

Now we come to another bit of evidence that ties up with the Babcock notations in the Fleming book of 1906. The late Robert H. Marriott wrote a remarkable history of early wireless in the USA entitled "Radio Ancestors," the only known copy of which was presented to the IRE by his widow Blanche B. Marriott in January 1952. Chapter XIII, 12 pages, is entitled "Doc Asked Bab To Stick in the Third Electrode." The present writer has made these abstracts:

"When I reached N.Y. in late 1907, C. D. Babcock was in charge of the United Wireless Factory; Cloyd Marshall, Secretary of the United at 42 Broadway, went to the factory daily for a conference with Babcock" (p. 1). [The plant was in Jersey City; de Forest was then out of United.] In the factory was "a Sprengle Mercury Vacuum pump" (p. 4). According to Babcock, de Forest had had the Fleming valve copied (p. 5). Bab quoted de Forest as having said in effect, "Bab, if two electrodies in a bulb make a detector, maybe more electrodes will make a better one," and asked Bab "to make up some vacuum tubes with three or four electrodes" (p. 6).

De Forest always maintained that he came upon the Audion from having experimented with gaseous conduction in flames, following early scientific work in Germany. He evidently he did experiment in that direction as early as about 1900. He would never admit having built upon Fleming's (or the somewhat earlier Wehnelt) thermionic tube, and he and Fleming had verbal battles about the matter.

Having taken that stand to get out from under the Fleming patent, de Forest was at a loss to explain how he did invent the triode. Having done so by the time-honored cut-and-try method, "feeling around" for a sensitive control, was nothing to be ashamed of at the time. Textbooks on electronics certainly did not teach how to do it!

The truth of the matter is that there was quite a gap between the scientists, who were interested in

discovering and measuring the electron and its properties, and the inventors who, knowing little of the science side, had to work their way along. They must have been guided by the cathode-ray oscilloscope with its "third electrode" in the form of an electromagnet or electrostatic plates for deflecting the cathode ray beam. This we see in German attempts at the electron amplifier that ran along contemporary with de Forest's Audion experiments and that also came to use an intermediate electrode for a form of control.

We can only surmise the groping process by which de Forest arrived at the magical grid form of electron tube. The inventor himself is not known ever to have revealed the approach and, with the lapse of time, may well have forgotten just what had happened. But the circumstances already cited and his own testimony in a certain patent suit make it evident that it was the Fleming Valve which he copied in the first place, and rechristened the Audion in his 1906 paper before the AIEE. The suit was an action of 1916 brought by the Marconi Wireless Telegraph Co. of America against de Forest. It charged infringement of the Fleming Valve US Patent No. 803,684, filed April 19, 1905, issued November 7, 1905. The suit was before Judge Julius M. Mayer of the US District Court, Southern District of New York, in New York City (In Equity No. F 12-31). The de Forest grid Audion was found to be an infringement of the Fleming patent. The decision was affirmed by the US Circuit Court of Appeals in a three-judge decision, which went so far as to quote from the London Electrician of November 21, 1913: "We think that Dr. de Forest might be more generous in his acknowledgement of the work of Dr. J. A. Fleming. Our readers generally will probably agree that the audion, although differing widely from the Fleming valve, is an offshoot of it." (The Audion here referred to is the grid, or triode, version.)

The Fleming valve patent was later annulled, the reason being the priority of Wehnelt, among other things. There was much more than Wehnelt in the way of priority, including Fleming himself. The patent was "over solicited" by Fleming's patent attorney. Certain claims were made much too broad and then forgotten, leading to its downfall. What happened is most interesting.

After WW I the Marconi Company brought suit against the USA in the Court of Claims for compensation for use of certain of its patents during the war, among them that of the Fleming valve. The government set up the defense that the patent was invalid, having claimed too much, and having entered a correcting disclaimer too late.

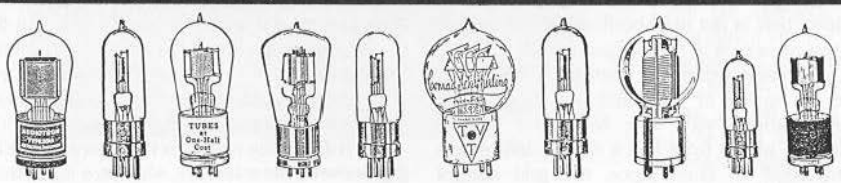
The government won in the Court of Claims, and again in the Supreme Court, which averred that the over claiming was not "inadvertent," and that the entering of the disclaimer had suffered an "unreasonable" delay. The Supreme Court opinion was rendered June 21, 1943. It appears in the US Patent Quarterly, Vol. 57, pp. 471-504.

While the annulment was a legal technicality, behind it is much interesting early work cited by the Court. This begins with Edison's patenting of the so-called "Edison effect" in US Patent No. 307,031 of 1884. This does not disclose unidirectional conductivity; the space current is used as a voltage controller, simply by virtue of the dependence of the space current upon the incandescence of the filament.

Next the Supreme Court quotes from Fleming's Royal Society paper of 1890 which cites a series of German scientists who used heated filaments to promote conduction across a vacuous space and realized unidirectional conduction (Hittorf, 1884; Goldstein, 1885; Elster and Geitel, 1889). Thus, it was Fleming's own recognition of all this prior advance that was the undoing of his US patent. A reading of the first claim will make evident its reading upon those earlier works: "1. The combination of a vacuous vessel, two conductors adjacent to but not touching each other in the vessel, means for heating one of the conductors, and a circuit outside the vessel connecting the two conductors."

The Wehnelt metallic-oxide cathode tube was the subject of a scientific paper in 1903, and of German patent No. 157,845, filed January 15, 1904 and issued January 13, 1905. It was an anticipation of both the Fleming-valve patent and de Forest's corresponding diode patents and paper of 1906.

It is difficult to account for how an invention took place. It is much more difficult to look forward and anticipate an invention, facing the curtain of ignorance that always lies ahead. But, cheer up, there is always opportunity on this sun-satellite of ours.



AN IMPROVED CROSS-INDEX OF ARMY VT-NUMBERS AND COMMERCIAL IDENTIFIERS

Tube collectors and restorers of early military equipment have a continuing need among for a reference source on U. S. Army VT-numbered tubes. The listing below attempts to provide more depth of coverage than the usual cross-reference chart. It combines locally available references with material kindly supplied by Bro. Pat Dowd, W2GK; Bill Smith, N9TT; and John Walker. Three specific sources were MIL-HDBK-213A, Military Handbook - Electron Tubes - Cross Index and Type Identification, 1963; NavShips 900119, Cross Index of Electron Tube Types, 1946; and the RSGB Service Valve Equivalents, 1947. Comments have been added to identify some of the more obscure items. The list has been cross-checked for errors.

A few of these tubes, for example the "special" VT-155, -156, and -159, remain a mystery. Some of these must have been highly secret at the time, like the subminiature tubes in the then-classified variable-time (VT) artillery fuze, the one based on a small radar. Others may have simply been items that never went into substantial production. Yet other numbers (VT-32, for example) were cancelled. Reader inputs on the "special" VTs are welcome!

Receiving tubes with a "Y" suffix (e. g., VT-132/12K8Y) have low-loss base material. Full information on most of the items not otherwise explained can be found in the tube listings in any ARRL Radio Amateur's Handbook of 1945-52 vintage. For civilian equivalents of tubes having Navy 38xxx numbers, see the November 1989 OTB, p. 31.

The list includes, in italics, the British CV (Common Valve) numbers that were assigned to most of these items. A warning: CV-numbers are not unique: several such numbers may apply to a given tube. Also be warned that there were Royal Air Force VTs (Valve, Transmitting) that were totally unrelated to U. S. tubes of the same VT-numbers: the VT20, VT25, VT45 . . . up through VT510.

The informed observer can detect clusters of VT-numbers that must have been added to accomodate specific new sets of equipment: VT-65, -66, and 86-88, for the BC-312 receiver (in the SCR-177B and related sets); the VT-131 through 139, for the BC-45x (SCR-274N) aircraft gear, ca. 1940; the VT-171 through VT-174, for the BC-611 (SCR-536) handi-talkie and BC-745 (SCR-511) "pogo stick" transceiver. Other likely clusters: the VT-177 to -179, 182, 183, and 185, for the BC-620 (SCR-509 *et al.*) "jeep radio"; or the VT-188 through -191, for the BC-645 (SCR-515) IFF set, ca. 1941. Some types are traceable to early Army radars of 1937-40 - see Don Helgeson's article in the November 1989 OTB.

A final note: the speed with which military electronics developed as WW II drew closer can be seen in this list. It took about 33 years (1917 to *ca.* 1940) for the first half of the list (VT-1 to VT-140, say) to develop. The second half required only about 2-1/2 years more (*ca.* 1940 to *ca.* 1943). At that point the Army gave up its special numbering system in favor of the Joint Army-Navy (JAN) prefix system for regular civilian type numbers. [LAS]

Some of the civilian type numbers for transmitting tubes reflect specific manufacturers. For reference purposes, letter prefixes used (over the time span of the VT-types and later) were as follows:

Amperex: A, CEP, HF, P, and ZB
Bomac Labs: BL (on experimental types)
Continental Electric: CE
Dumont: B, K (experimental)
Eitel-McCullough: RX, UH, and numbers like 100TH or 304TL
Electronic Enterprises: EE
Electrons Inc.: EL
Federal Telephone and Radio: F
General Electric: FA, FG, FJ, FP, FR, GL, NE, PJ, PR, and PT (Z, ZP, and ZG on experimentals)
Heintz and Kaufman: HK
Hytron: HY (D and HD on experimentals)
Machlett Labs: ML (EP on experimentals)
RCA: A, C, or R (on experimentals)
Raytheon: CK, RK, RKR, RM, and RX (QF, QG, QK, QL, QM, QMG, QT, and QY on experimentals, klystrons, etc.)
Sperry: SAC, SAL, SRC, SRL, and SRX (on experimentals and klystrons)
Sylvania: R (SB, SD, SN, and X on experimentals and special items)
Taylor: R, T, TT, TZ, and TW
Tung-Sol: DT (on experimentals)
United Electronics: BM, CV, CW, HV, UE, and UX (yes, UX!)
Varian Associates: VA (V on experimentals)
Western Electric: D, GA, and WE (XQ as a suffix on experimentals)
Westinghouse: DK1, DRJ, DRO, KU, KX, K1, RO, and WL (WX on experimentals)

VT-1 WE 203A (Navy CW-933)
VT-2 WE 205B (Navy CW-931)
VT-3 None (WE)
VT-4A WE 211A (Navy CW-1818)
VT-4B 211 (PR-11-A; WL-410; Navy CG-1984) and WE 211D (Navy CW-1818A; D80039)
VT-4C JAN 211 *[CV620]*
VT-5 WE 215A (D80-050; Navy CW-1344)
VT-6 WE 212A (Navy CW-1819)
VT-7 WX-12
VT-8 UV-204 (PR-4-A)
VT-10 GE "P" (prototype of UV-204), Navy CG-916
VT-11 GE "G," Navy CG-890 (early)
VT-12 GE "T"
VT-13 GE "G" ruggedized (prototype of UV-201), Navy CG-890 (later version)
VT-14 GE "T" (prototype of UV-202), Navy CG- or CW-1162
VT-16 GE "T" ruggedized
VT-17 860 (PT-860; WL-415 *[CV640]*)
VT-18 GE "U" (prototype of UV-203), Navy CG-1144
VT-19 861 (PR-861; WL-407; 3124A; *[CV641]*)
VT-20 None (de Forest)
VT-21 None (de Forest)
VT-22 204A (PR-4-B; Navy CG-1860A; *[CV2563]*)
VT-24 864 (FR-300); *[CV2675]*)
VT-25 10 (PT-10-A; *[CV603]*)
VT-25A 10Y
VT-26 22
VT-27 30 (Navy SE-3872) *[CV604]*
VT-28 24, 24A *[CV936]*
VT-29 27 *[CV944]*
VT-30 01A (PR-1-B; Navy SE-4374; *[CV750]*)
VT-31 31 *[CV931]*
VT-33 33 *[CV949]*
VT-34 207 (CG-1971)
VT-35 35/51 *[CV1752]*
VT-36 36 *[CV1775]*
VT-37 37 *[CV606]*
VT-38 38 *[CV712]*
VT-39 869 (PJ-26; Navy SE-3071)
VT-39A 869A *[CV2723]*
VT-40 40 *[CV2501]*
VT-41 851 (PR-51-A; Navy CG-2172; *[CV-2671]*)
VT-42 872 (FG-19; Navy SE-3070; *[CV642]*)
VT-42A 872A, sp. fil.
VT-43 845 (WL-412; *[CV735]*)
VT-44 32 *[CV711]*
VT-45 45 *[CV596]*
VT-46 866 (PJ-28; Navy SE-3069; *[CV32]*)
VT-46A 866A
VT-47 47 *[CV1772]*
VT-48 41 *[CV608]*
VT-49 39/44 *[CV1771]*
VT-50 50 *[CV2533]*
VT-51 841
VT-52 45 Special (Navy 38142; 2C45) (fil. 7 V @ 1.18 A)
VT-53 (repl. by VT-42A)
VT-54 34 *[CV1751]*
VT-55 865 (PJ-27; Navy SE-3294; 3394; *[CV-2676]*)
VT-56 56 *[CV611]*
VT-57 57 *[CV612]*
VT-58 58 *[CV613]*
VT-59 59 *[CV2538]*
VT-60 850
VT-62 801, 801A *[CV-621]*
VT-63 46 *[CV2531]*
VT-64 800 (RK30; *[CV2657]*)
VT-65 6C5 *[CV582]*
VT-65A 6C5G *[CV581]*
VT-66 6F6 *[CV1186]*
VT-66A 6F6G *[CV-1911]*
VT-67 30 (porcelain base)
VT-68 6B7 *[CV1891]*
VT-69 6D6 *[CV1900]*
VT-70 6F7 *[CV1915]*
VT-72 842
VT-73 843 *[CV639]*
VT-74 5ZA *[CV1864]*
VT-75 75 *[CV614]*
VT-76 76 *[CV615]*
VT-77 77 *[CV616]*
VT-78 78 *[CV2544]*
VT-80 80 *[CV617]*
VT-83 83 *[CV1773]*
VT-84 84/6ZA *[CV619]*
VT-86 6K7 *[CV1942]*
VT-86A 6K7G *[CV1941]*
VT-86B 6K7GT *[CV-1943]*
VT-87 6L7 *[CV1951]*
VT-87A 6L7G *[CV1951]*
VT-88 6R7 *[CV1963]*
VT-88A 6R7G *[CV1962]*
VT-88B 6R7GT *[CV-1964]*
VT-89 89 *[CV833]*
VT-90 6H6 *[CV1301]*
VT-90A 6H6GT *[CV-1931]*
VT-91 6J7 *[CV1074]*
VT-91A 6J7GT *[CV1937]*
VT-92 6Q7 *[CV588]*
VT-92A 6Q7G *[CV589]*
VT-93 6B8 *[CV1894]*
VT-93A 6B8G *[CV1893]*
VT-94 6J5 *[CV1067]*
VT-94A 6J5G *[CV1932]*
VT-94B 6J5 selected
VT-94C 6J5G selected
VT-94D 6J5GT *[CV1934]*
VT-95 2A3 *[CV1831]*
VT-96 6N7 *[CV1957]*
VT-96B 6N7 selected
VT-97 5W4 *[CV1849]*
VT-98 6U5/6G5 *[CV504]*
VT-99 6F8G *[CV1917]*
VT-100 807 (HY61, A4051; *[CV124]*)
VT-100A 807 modified
VT-101 837 (RK44, A4002B; *[CV637]*)
VT-103 6SQ7 *[CV1990]*
VT-104 12SQ7 *[CV546]*
VT-105 6SC7 *[CV1969]*
VT-106 803 (RK28A, WE 322A; *[CV623]*)
VT-107 6V6 *[CV510]*
VT-107A 6V6GT *[CV-511]*
VT-107B 6V6G *[CV509]*
VT-108 450TH (WL-450, HK854H, 3-450A4)
VT-109 2051 (WL630; *[CV1798]*)
VT-111 5BP4 (1802P4; *[CV836]*)
VT-112 6AC7/1852 *[CV660]*
VT-114 5T4 *[CV276]*
VT-115 6L6 *[CV208]*
VT-115A 6L6G *[CV1947]*
VT-116 6SJ7 *[CV70]*
VT-116A 6SJ7GT *[CV590]*
VT-116B 6SJ7Y *[CV866]*
VT-117 6SK7 *[CV1981]*
VT-117A 6SK7GT *[CV1982]*
VT-118 832 *[CV634]* (Also see VT-286.)
VT-119 2X2/879 *[CV-248]*
VT-120 954 (2A2; *[CV1095]*)
VT-121 955 (HA2; *[CV1059]*)
VT-122 WL-530 (GL-530) (water-cooled triode)
VT-123 A-5586 (replaced by VT-128)
VT-124 1A5GT *[CV756]*
VT-125 1C5GT *[CV1805]*
VT-126 6X5 *[CV279]*
VT-126A 6X5G *[CV572]*
VT-126B 6X5GT *[CV574]*
VT-127 100S
VT-127A 100TS (WL-534, 534, 3-100D2)
VT-128 1630 (A-5588A, 12H; *[CV2715]*)
VT-129 304TL (525; WL525; HK304TL; 3-300A2)
VT-130 250TL (806; HK454L; 3-250A2)
VT-131 12SK7 *[CV543]*
VT-132 12K8Y *[CV24]*
VT-133 12SR7 *[CV700]*
VT-134 12A6 *[CV525]*
VT-135 12J5GT *[CV535]*
VT-135A 12J5 *[CV534]*
VT-136 1625 (12-V, 7-pin 807; *[CV659]*)
VT-137 1626 *[CV1755]* (12-V triode intended for stable VFOs)
VT-138 1629 *[CV1756]* (12-V octal 6E5)
VT-139 0D3/VR-150 *[CV216]*
VT-140 1628 (Repl. by 8012A; see VT-228.)
VT-141 WL-531 (vacuum rectifier)

VT-142 WE 39DY1 (doorknob triode)
VT-143 805 (WE 331A; RK57; *[CV625]*)
VT-144 813 *[CV26]*
VT-145 5Z3 *[CV275]*
VT-146 1N5GT *[CV37]*
VT-147 1A7GT *[CV2]*
VT-148 1D8GT *[CV1811]*
VT-149 3A8GT
VT-150 6SA7 *[CV1966]*
VT-150A 6SA7GT *[CV-1967]*
VT-151 6A8G *[CV16]*
VT-151B 6A8GT *[CV580]*
VT-152 6K6GT *[CV207]*
VT-152A 6K6G *[CV1938]*
VT-153 12C8Y *[CV128]*
VT-154 814 (RK47; *[CV629]*)
VT-155 to **157** "Special"
VT-158 "Special" (Zahl 600-MHz oscillator)
VT-159 to **160** "Special"
VT-161 12SA7 *[CV537]*
VT-162 12SJ7 *[CV697]*
VT-163 6C8G *[CV1896]*
VT-164 1619 *[CV723]* (2.5-V filament-type version of 6L6)
VT-165 1624 (A4154D) (2.5-V filament-type version of 807)
VT-166 WE 371A (vacuum rectifier)
VT-167 6K8 *[CV18]*
VT-167A 6K8G *[CV1944]*
VT-168A 6Y6G *[CV205]*
VT-169 12C8 *[CV128]*
VT-170 1E5GP *[CV45]*
VT-171 1R5 *[CV782]*
VT-171A (loktal version of 1R5)
VT-172 1S5 *[CV124]*
VT-173 1T4 *[CV35]*
VT-174 3S4 *[CV183]*
VT-175 1613 (HY-6F6GX; *[CV655]*) (6F6, xmtg-rated)
VT-176 6AB7/1853 *[CV66]*
VT-177 1LH4 *[CV780]*
VT-178 1LC6 *[CV3]*
VT-179 1LN5 *[CV781]*
VT-180 3LF4 *[CV187]*
VT-181 7Z4 *[CV252]*
VT-182 3B7/1291 *[CV-228]*
VT-183 1R4/1294 *[CV-91]*
VT-184 0B3/VR-90
VT-185 3D6/1299 *[CV-187]*
VT-186 "Special"
VT-187 575A (975A; UE975A; F375A; GL512A; WL575A; 512; 375A) *(not WE 375A)* (gas rectifier)
VT-188 7E6 *[CV891]*
VT-189 7F7 *[CV893]*
VT-190 7H7 *[CV75]*
VT-191 WE 316A (ZP-470) *[CV683]* doorknob triode
VT-192 7A4 *[CV1770]*
VT-193 7C7 *[CV76]*
VT-194 7J7 *[CV22]*
VT-195 1005 (CK1005; QMG159; *[CV2874]*)
VT-196 6W5G *[CV279]*
VT-197A 5Y3GT/G *[CV1268]*
VT-198A 6G6G *[CV-1926]*
VT-199 6SS7 *[CV70]*
VT-200 0C3/VR-105 *[CV686]*
VT-201 25L6 *[CV220]*
VT-201C 25L6GT *[CV551]*
VT-202 9002 *[CV664]*
VT-203 9003 *[CV665]*
VT-204 HK24G (3C24; 3-25D3; 25TG; *[CV-745]*)
VT-205 6ST7 *[CV109]*
VT-206A 5V4G *[CV729]*
VT-207 12AH7GT *[CV529]*
VT-208 7B8 *[CV22]*
VT-209 12SG7 *[CV694]*
VT-210 1S4 *[CV181]*
VT-211 6SG7 *[CV1978]*
VT-212 958 *[CV650]*
VT-213A 6L5G *[CV151]*
VT-214 12H6 *[CV916]*
VT-215 6E5 *[CV239]*
VT-216 816 (866 Jr.; *[CV724]*)
VT-217 811 *[CV628]*
VT-218 100TH (3-100A4; *[CV2552]*)
VT-220 250TH (3-250A3; RK63; HK-454H; *[CV2589]*)
VT-221 3Q5GT *[CV185]*
VT-222 884 (6Q5G; RX884; *[CV647]*)
VT-223 1H5GT *[CV104]*
VT-224 RK34 (2C34; *[CV18]*)
VT-225 WE 307A (RK-75; *[CV2612]*)
VT-226 3EP1 (1806P1; *[CV817]*)
VT-227 7184 (KR7184) (pentode like 6V6)
VT-228 8012 (A2139; *[CV662]*) (UHF triode; also see VT-140.)
VT-229 6SL7GT *[CV-171]*
VT-230 WE 350A (RK-49; T21; *[CV2629]*)
VT-231 6SN7GT *[CV-170]*
VT-232 E-1148 (HY-E1148; *[CV6]*) (British 3.5-W triode)
VT-233 6SR7 *[CV109]*
VT-234 HY-114B *[CV-3505]*
VT-235 HY-615 (615; *[CV3506]*)
VT-236 836 *[CV636]*
VT-237 957 *[CV2700]*
VT-238 956 *[CV649]*
VT-239 1LE3
VT-240 WE 710A (8011; WL538; A2137; Brit. VT90; *[CV46]*)
VT-241 7E5/1201 *[CV-890]*
VT-243 7C4/1203A *[CV2705]*
VT-244 5U4G *[CV276]*
VT-245 2050 *[CV2565]* (thyratron)
VT-246 918 (CE-1; 59A3; *[CV2692]*) (gas phototube)
VT-247 6AG7 *[CV207]*
VT-248 3CP1 (1808P1; C7510)
VT-249 1006/CK1006
VT-250 EF50 *[CV78]* (British 9-pin metal-can loktal-style pentode; also their VR91 and ARP35)
VT-251 441 (GL-441) (phototube. Note: *WL-441*/2J32 is a magnetron.)
VT-252 923 (CE-23; 84A3; WL741) (Gas phototube)
VT-254 304TH (535; 3-300A3; WL535; HK-304TH; *[CV2611]*)
VT-255 WE 705A (RK-705A; WE 378A; D159780; 8021; *[CV3587]*) (rectifier)
VT-256 GL-486 (ZP-486; 3J26) (magnetron)
VT-257 K-7 (2J30) (2.9-GHz magnetron)
VT-259 829 *[CV632]*
VT-260 0A3/VR-75
VT-264 3Q4 *[CV182]*
VT-266 1616 (2B26; *[CV2679]*)
VT-267 WL-578 (578; 2-100A; 100R; 100A; 451; GL451; ZP451; 8020; R6174) (vacuum xmtg rectifier)
VT-268 12SC7 *[CV-540]*
VT-269 WE 717A *[CV-3594]*
VT-277 417 (WL417; WL417A) (3-GHz klystron like SRL-7; *not the WE 417A/5842*)
VT-279 GY-2 (D-161-831; 1278-GY2) (thyratron)
VT-280 C7063 (1P24; 936; 516; GL-516; ZP516; GL-564) (vacuum phototube)
VT-281 HY-145ZT (HY-115; 2E28) (subminiature pentode)
VT-282 ZG489 (thyratron)
VT-283 QF-206/2E27 (subminiature pentode)
VT-284 QF-197/2B24 (submin. filament-type diode)
VT-285 QF-200C/2C27 (subminiature triode)
VT-286 832A *[CV634]* (Also see VT-118.)
VT-287 815 *[CV2663]*
VT-288 12SH7 *[CV922]*
VT-289 12SL7GT *[CV-924]*

MEET THE COLLECTORS

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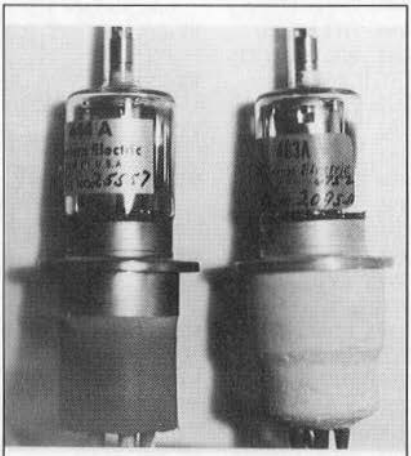
THE *Western Electric* 444A & 463A TRAVELING-WAVE TUBES

In the mid-1950s, AT&T embarked on a program of expansion, establishing new microwave routes throughout the U. S. Each channel of microwave carried one mastergroup of frequency-division multiplex, which was equivalent to 600 message channels.

Included in this plan was the central office at Jennerstown, Pennsylvania, on the west side of the state near Johnstown. It was to be equipped with 4-GHz microwave using Western Electric TD-2 equipment, operating in several directions. TD-2 at the time provided five working channels and one spare, with automatic switching. If a working channel should fade or fail, service would automatically switch to the spare.



Left: the 444A, 6-GHz final amplifier rated at 6 watts and 33 dB gain. Right: the 463A, carrier-supply amplifier rated at 1 watt and 24 dB gain. Leads encased in silicone rubber.

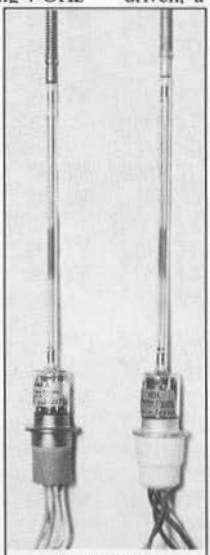
In 1959, further expansion began. 6-GHz channels were to be added to two existing 4-GHz routes. Each channel would carry three-plus mastergroups or 1860 message channels. The equipment to be used was the new WE TH-1, which utilized a traveling-wave tube (TWT) as its final amplifier instead of the grounded-grid 416B amplifiers of the TD-2.

In the TWT, electrons are emitted by the cathode, focused by the anode, and sent through a magnetic field toward a positively charged collector. The incoming signal is coupled via a waveguide to a spiral electrode called a helix. The helix slows the velocity of the incoming wave so the negative cycles of the wave "bunch" the electrons into groups. This increases the amplitude of the wave as it travels the length of the tube in the cavity. Up to a point, the longer the tube, the greater the gain.

To house this additional microwave and carrier-telephone equipment, a two-story addition was to be added to our office. The existing diesel alternator for emergency power was to be replaced by two 220-kW units. To heat and cool the new area plus the existing office, a wholly new heating and air-conditioning system was to be installed.

In December 1959, land adjacent to the building was cleared and excavation began. As the winter progressed, the foundation was poured and walls begun, all under a large plastic canopy.

In 1961 the addition was complete. The existing building was enclosed in a reinforced concrete shell and a massive installation of microwave, multiplex, and associated equipment plus additional power plant began. The TH power plant was 230-V 60-Hz alternators, AC- or DC-driven, a modification of the power plant used for supplying power on the center conductor of coaxial toll cables and used for powering unattended repeaters. The TWT assemblies were continuously cooled by AC blowers with two DC backups.



Full length.

During 1961 and 1962, we turned up the new equipment and put service on it. Also, in the spring of 1961, a TH test bench was installed for servicing defective units. From then until my recent retirement this bench was one of my work locations. It was a challenging experience, the servicing of the carrier resupplies giving me good foundation, made much easier by the introduction of the digital volt-ohmmeter. (Resupplies put RF carrier on a failed channel to prevent noise buildup in the working channels.)

The early TWTs and power supplies

(Continued on p. 39)

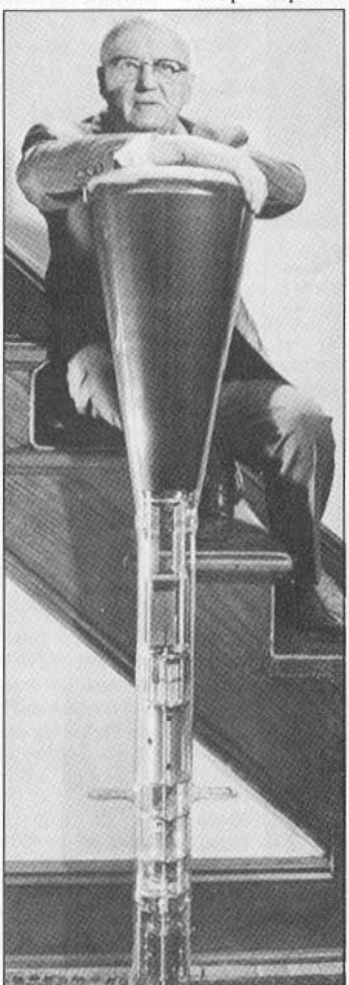
BELL LABS DEVELOPMENTAL CRT IN AWA MUSEUM

The pictures show a remarkable television picture tube now in the AWA Museum Annex. Part of the Tyne tube collection, it was contributed recently by Gertrude Tyne. It's an interesting design, but not for its unusual size alone.

BACKGROUND. The tube was designed in the mid-Thirties by Bell Laboratories physicist Clinton J. Davisson, who incidentally shared the 1937 Nobel Prize in physics for the discovery of diffraction of electrons by crystals, collaborating with C. J. Calbick. At the time, the Laboratories were developing intercity TV transmission systems. In order to examine the transmission impairments of the long-haul line, a highly precise program source and a top-quality display device were needed. As a result, the tube was a theoretical investigative device rather than a prototype for production.

Regardless of design intent, it figured in two early tests of long-distance television transmission. In a 1937 trial, 35-mm motion pictures were sent over the then-experimental coaxial cable from New York to Philadelphia. The cable system had an 800-kHz bandwidth, suitable for 240-line television.

The test system was semi-electronic. The transmitter was a scanning disc of *six-foot* diameter, developed by Herbert E. Ives as veteran of previous disc-TV developments. The 240 lenses set into it, spaced over only about 1.5 inches of radial distance near the edge of the large disc, generated a 240-line, 24-frame picture with a nearly rectangular raster, not the visible spiral usually found in disc systems. The advantage of this mechanical scanner was that its sweep was precise and stable compared to that of electronic cameras available at the time. The received picture, of course, appeared on an early model of the CRT. The special tube apparently gave appreciably better picture fidelity than the commercial picture tubes (the 1802-P4/5BP4, 1803-P4/12AP4, 1804-P4/9AP4, etc.) of the day.

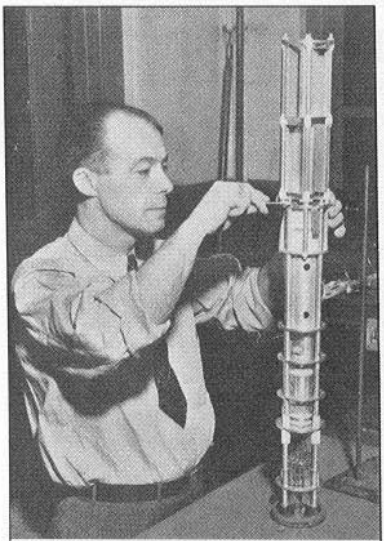


Gerry Tyne and "The Tube," 1965
Reprinted with permission from the Bell Telephone Laboratories Reporter.

The tube was also part of the Bell System exhibit at the New York World's Fair of 1939.

The later tests occurred in 1941. By that time the coaxial-cable equipment had developed into a prototype of the L1 carrier system, which offered a 2.7-MHz bandwidth sufficient for 441-line 30-frame television. The camera this time was a Farnsworth image dissector, again used with 35-mm film. The display was a refined version of the tube, with beam voltage raised from 5 kV to 10 kV for doubled brightness.

PHYSICAL FEATURES. The tube, has a 12" face and 54" length. Its developmental number is unknown but the tube in a photo ca. 1937 and the AWA sample are prominently marked "T-12-4." In the 1937 demo it gave a picture of 7" by 8". The deflection angle is very small, about 10 degrees, in the interests of high picture fidelity without pincushioning or barrel distortion. That is a *very* small angle compared to today's television tubes with their angles of 110 or 114 degrees. Deflection is electrostatic, differing from later electromagnetic tubes. As installed in a monitor, two electromagnets at right angles



Tube being assembled, 1941.
Reprinted with permission from the Bell Laboratories Record. Copyright 1941 AT&T.

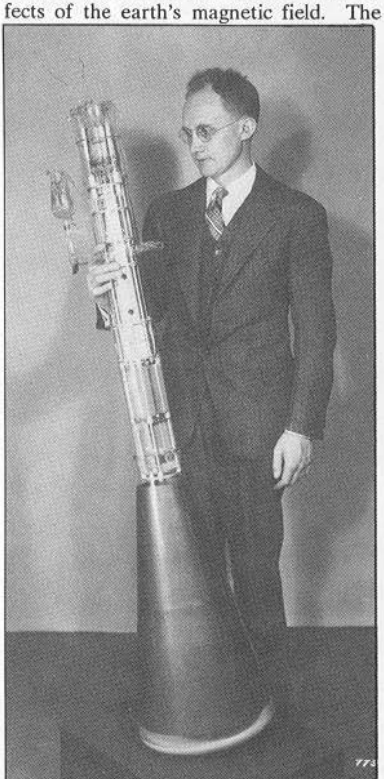
provided centering and canceled the effects of the earth's magnetic field. The original version of the tube was continually pumped, with a tantalum-filament manometer (the "appendix" visible in original photos) to monitor the vacuum. The later version was sealed off, but with the manometer still present: it provided getter action. The tube is unbased; 14 wire leads come out the gun end. Close inspection shows a great deal of precision machine work inside, high-voltage leads insulated with tiny glass tubing, and plate assemblies held with long threaded tie rods.

It is irresistible to speculate on whether this was the longest *all-glass* tube ever made. The UV-862 "100-kW" tube was six inches longer, but only a third of its length was glass. The Western Electric 320A 150-kW tube was 94 inches long, but about three feet of that length was copper. Today's multimegawatt klystrons are much longer, at seven feet or more, but are all metal and ceramic.

ELECTRICAL FEATURES. The electron gun starts with a filament, a cross-shaped piece of tungsten foil, heated with one volt DC at 10 amps. The tube operated "upside-down" compared to later CRTs: the filament was several kV below ground, with the screen end being grounded. Modern CRTs use a grid to control the intensity of the electron beam. This one uses a unique aperture system: the beam passes through a small square opening in a metal target. To reduce beam current in accordance with dark areas in the picture, a pair of auxiliary deflection plates divert the beam away from the hole and into the target. The beam emerges square in shape. Once formed in this "deflection modulation" electron gun, the beam travels toward the screen through vertical and horizontal deflection plates as usual. The shaped beam gave a *square* spot and a filled-in raster, with little evidence of scan lines.

HISTORY. About a dozen units were made; the AWA sample is the only known survivor. It was presented to Gerald Tyne, then at the West Street location of the Labs in New York City, in 1947, more or less as a joke. He took it home on the subway.

REFERENCES. The 1937 240-line trial, with pictures of the disc scanner and the tube, is covered in "Coaxial Cable System for Television Transmission" in the Bell System Technical Journal for July 1938 and, more fully, in the Bell Laboratories Record of February 1938. The 1941 image-dissector film chain is documented in "Film Scanner for Use in Television Transmission Tests" in the IRE Proceedings for May, 1941. The history of the tube appears in "The Davisson Cathode Ray Television Tube Using Deflection Modulation" in the BSTJ of October 1951. The tube is mentioned briefly on pp. 144-145 of the Electronics Technology volume of the History of Engineering and Science in the Bell System. Assembly of the electron gun is pictured in the BTL edition of the June 1941 Bell Laboratories Record. Finally, Gerry Tyne is pictured proudly with the tube in the Bell Labs "Reporter" for March-April 1965. [LAS]



C. J. Calbick and friend, ca. 1937.

In 1937 RCA produced a CRT also 4-½ feet long, but all-metal except for the faceplate, which was 31" in diameter and gave direct-view pictures 18" x 24". This was about the time that RCA standardized production of CRTs (the 5BP4, 9AP4 and 12AP4) for the sets to be introduced in 1939. Du Mont, prior to the war, offered sets with 14" direct-view CRTs and had just started production on models with 20" screens. It wasn't until after the war that RCA produced anything larger commercially. [Jack Davis]

TIPS ON COLLECTING ANTIQUE INCANDESCENT LAMPS

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For purposes of marking the progress of technology, the thermionic age began on October 21, 1879, when, after numerous experiments, Thomas Edison succeeded in making a commercially producible incandescent lamp. Other experimenters and scientists had made investigations into such devices, but Edison's invention gave birth to the field of practical electrical illumination. In studies to improve the quality of the lamp filament, he discovered the "Edison effect" which eventually led to the vacuum tube, first with the Fleming diode and finally with the de Forest audion.

Thermionics is not the purpose of this article, but the opening lines emphasize to historians and collectors the importance of the incandescent lamp in the evolution of electricity and electronics, and point out the rewards of starting a representative collection of these glowing gizmos.

Different approaches can be used to organize a collection. According to my experience, the most direct path is to use the main technological innovations of the incandescent lamp as a historical guide. Thus, samples gathered in can easily be appraised in terms of manufacturing date, rarity, origin, and so on. The table gives the main design changes in the electric lamp since the beginning of the 20th century.

Where do we find antique lamps? Being fragile, they are generally hard to find; the majority of the vast heap produced by the industry was thrown away after burning out or breaking in handling. Flea markets and junk shops are the best sources of such lamps. Another profitable source is antique dealers who specialize in old-time candelabra or other old lighting fixtures. And the replicas? Yes, as the name indicates, they are close reproductions of antique lamps, made generally for a commemorative or promotional purpose. They are naturally easier to find than the originals and enrich the collection.

For a neat display, the lamps are fixed in porcelain sockets; those in good condition can be lighted from a dimmer for applying a controlled low voltage to show off the filament structure, as illustrated in two of the photos.

Of course, there are specialty items: unique bulbs for cars, ships, Christmas trees, etc. However, through these brief lines the author only intends to suggest to collectors how to start a representative collection of old-time lamps.

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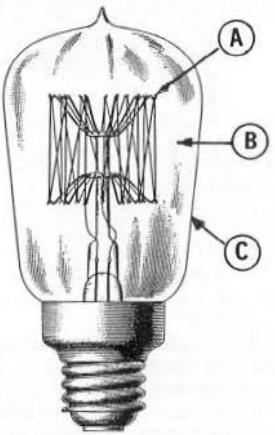
Gerald F. J. Tyne, Saga of the Vacuum Tube, Howard W. Sams, Indianapolis, 1977.

John W. Stokes, 70 Years of Radio Tubes and Valves, 1982, orderable from the Vestal Press, Vestal, NY.

General Electric Co., Pictorial History of the Edison Lamp, 1929, reprint from Vestal Press.

H. A. G. Hazeu, Fifty Years of Electronic Components, Elcoma Product Division, N. V. Philips Gloeilampenfabriken, Holland.



MAIN INNOVATIONS OF THE INCANDESCENT LAMP

1905 - Filament (A). W. R. Whitney invents the metallized carbon filament. Efficiency 4.25 lumens/watt.

1907 - Filament (A). First lamps using tungsten filaments. Output 8 lumens/watt.

1911 - Filament (A). W. D. Coolidge devises the metallurgical process of wrought tungsten, giving very fine wires for filaments. Efficiency 10 lumens/watt.

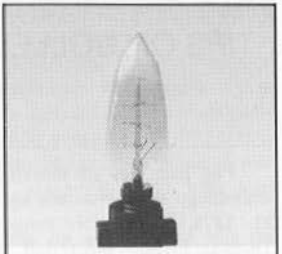
1913 - Internal Environment (B). Through research of Irving Langmuir, lamps begin to use inert-gas filling to retard evaporation of the filament.

1919 - Bulb Configuration (C). First bulbs without sealing tips due to improved production process.

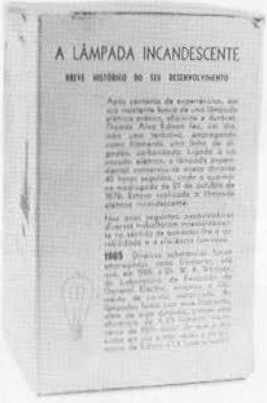
1925 - Bulb Configuration (C). First lamps using frosted glass for better light diffusion.-

Lamp made in Germany by Osram, ca. 1920, operating through a dimmer to show filament structure.

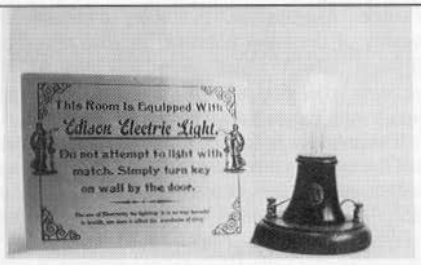
Bulb in candelabrum, obtained from a dealer in antique lighting fixtures, operating from a dimmer.



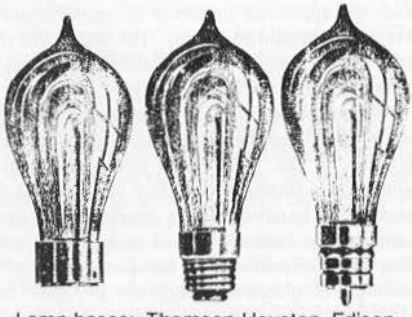
Another antique lamp, again from a source of old fixtures.



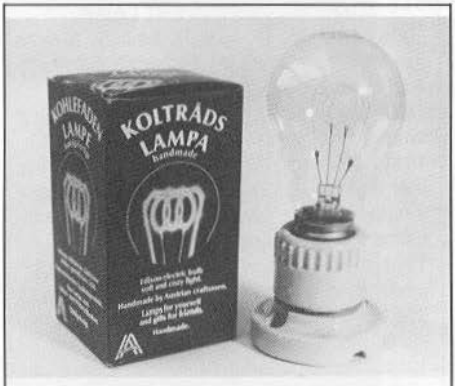
Box from replica of Edison lamp, made by General Electric do Brasil ca. 1954, to commemorate the 400th anniversary of the city of Sao Paulo. Text gives brief history of bulb development. Found in a flea market.



GE replica in operation. The metal plate, from Vestal Press, gives the display a particular touch.



Lamp bases: Thomson-Houston, Edison, Sawyer-Man (N. Hawkins, New Catechism of Electricity, 1896).



Replica of a later Edison lamp, made by an Austrian company for display purposes, showing old-type filament. Obtained in Denmark.

SOME FURTHER NOTES

(1) Originally it was necessary to use platinum for the leadout wires through the stem press, to match the coefficient of expansion of the glass. A significant cost reduction came with the introduction of Dumet (bimetallic) wire for the base press. Very early bulbs have visible splices where the precious platinum is extended inside the lamp by cheaper wire. (2) These lamps were intended for 100-110 V. Today's 120-V power stresses them badly. Use a dimmer! (3) Carbon-filament bulbs are back in production; ads in the Old-House Journal offer them for Victorian lighting effects.

The following synopsis of U. S. bulb construction is excerpted from an item by Floyd Lyons, now deceased, in OTB Vol. 4 No. 4, Winter 1963-64.

LET THERE BE LIGHT

There is a hobby which cannot be extinguished, as it were. We are speaking of light-bulb collecting. This writer knows of only five serious, private collector-historians in the field, one of whom lives in Australia.

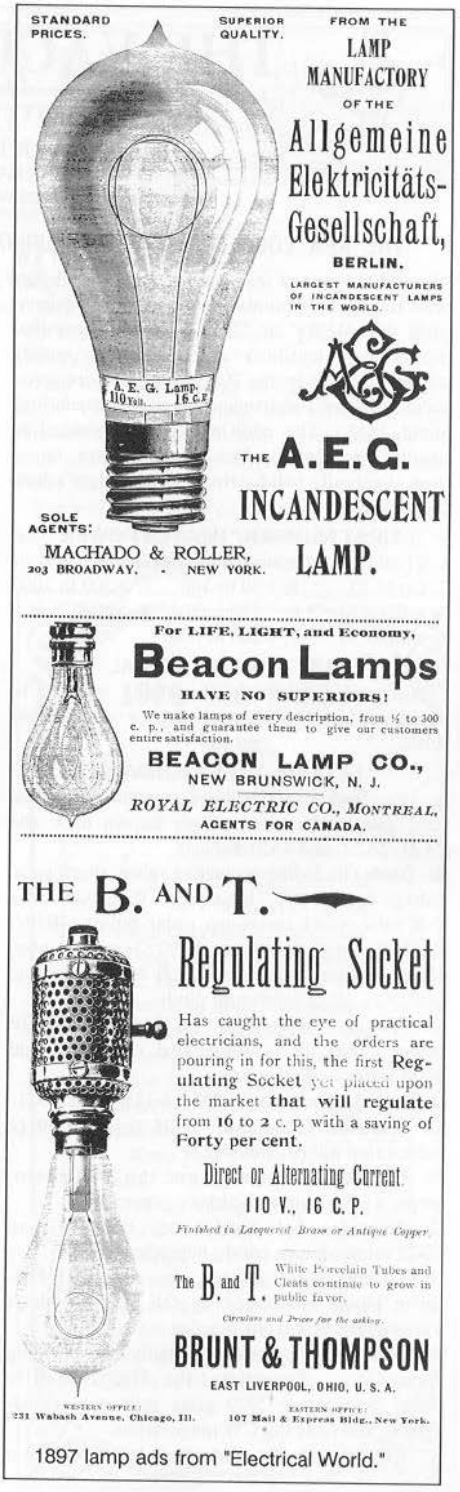
There are still many interesting light bulbs to be collected, although the early ones are becoming more and more rare. Of course, the Edison lamps take on primary interest. To be added to this "Academy of Light" are such other famous names as Maxim, Sawyer-Man (forerunner of Westinghouse), Thomson-Houston (later to be GE), Schaefer, Heisler, and Bernstein. There were roughly a dozen light-bulb companies flourishing in the U. S. by 1890. Competition was keen, and by 1900 these were narrowed down, mainly to the present-day companies.

The first question asked by a visitor to my amateur museum is "How does one determine the age of a light bulb?". Here are a few broad, general rules.

Hairpin-shaped filaments made from bamboo were used exclusively up through 1893. Prior to 1898, all bulbs were elongated or short pear shape. The pinch top (tip) was generally discontinued about 1918. All lamps were rated by candlepower (C. P.) up through 1905. The filaments were fastened to the lead-in wires by platinum and nickel clamps in 1880; by copper plated 1881-1886, and carbon paste was then used up to 1918. Inside frosting did not appear until 1925.

Rectangular labels were pasted on the glass envelope up to about 1900 with information as to C. P. and patent rights. Round labels were in vogue after the turn of the century; they usually included C. P. and voltage ratings.

Plaster of paris was used as insulation in the base up through 1899; white porcelain was used in 1900 only, and the present-day black glass has been in use since 1901.



1897 lamp ads from "Electrical World."

THE VACUUM TUBE

EDITED BY
BRO. PATRICK DOWD, F.S.C.,
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THE RMA CODE FOR SPECIAL-PURPOSE TUBES AND SOLID-STATE DEVICES

About 500 types of transmitting and special-purpose tubes carry number-letter-number designations like "4D21" or "2E26." These somewhat mysterious identifiers come from a coding scheme devised by the Radio Manufacturers Association (now Electronic Industries Association) about 1942. The code was later expanded to handle new devices like traveling-wave tubes, then eventually solid-state devices. Here's how the code worked.

FIRST NUMBER: HEATER POWER

1: 0 (cold-cathode; no filament or heater)
2: Up to 10 5: >50 to 100 8: >500 to 1000
3: >10 to 20 6: >100 to 200 9: >1000
4: >20 to 50 7: >200 to 500

LAST NUMBER: SERIAL

Assigned sequentially, beginning with 21 to avoid confusion with receiving or cathode-ray tubes.

LETTER: TYPE OF DEVICE

A: Single-element (ballasts, vacuum-type resistors, gauge tubes, etc. Only known uses: the 2A21, 2A22, and 4A21 ballasts.

B: Diode (including protective tubes, spark gaps, voltage regulators). Examples: the 1B24 radar T-R tube, 1B41 series-gap radar pulser, 1B59/-R1130B crater-glow lamp, 1B90 Geiger counter, 1B126 gamma-ray counter, 2B21 rectifier (a rugged 2X2), 2B22 lighthouse diode.

C: Triode. Examples: 2C39 disc-seal UHF power triode, 2C51/396A dual miniature, and 9C25 water-cooled triode.

D: Tetrode Examples: 4D21/4-125A and 7D21.

E: Pentode. Examples: 2E26 octal, 3E29 (a pulse-rated 829B), and 4E27.

F: Hexode. Only known use: the 2F21 monoscope, a television test-picture generator.

G: Heptode. Sole known use: the 2G21 and 2G22 subminiature triode-heptodes.

H: Octode. Only known use: the 2H21 Phasitron phase modulator, in GE FM broadcast transmitters of the late Forties.

J: Magnetically controlled, usually incorporating a resonator. Examples: the 4J30 2900-MHz cavity magnetron; 5J29 glass split-anode magnetron, and 6J21 big CW magnetrons.

K: Electrostatically controlled, incorporating a resonator (velocity-modulated tubes, klystrons, inductive-output tubes). Examples: the 2K26/-397A 7000-MHz klystron and 4K34 large 3000-MHz klystron.

L: Vacuum capacitors. Only known uses: the 1L21 through 1L25. For example, the GL-1L21 provided about 12 pF at 20 kV.

N: Crystal rectifiers; later, **solid-state devices**. Examples: 1N21 diode, 2N2222 transistor, 3N98 transistor, 4N26 optoisolator, 6N21 optocoupler.

P: Photoemissive (phototubes, photomultipliers, pickup tubes). Examples: 1P25 "snooperscope" tube, 1P30 phototube, and 2P23 image orthicon.

Q: Cavities. Only known uses: the 1Q21 through 1Q26A, for example, the WL-1Q22 9250-MHz reference cavity.

R: Ignitrons, pool tubes. Only known use: the 1R21/5550 mercury pool ignitron.

S: Switches. Sole known use: the 1S22 vacuum switch.

T: Storage, radial-beam, and other special deflection control tubes.

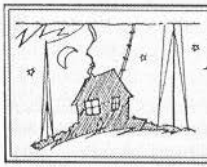
V: Photoflash. **X: X-ray.**

W: Traveling-wave. **Y: Thermionic converters.**

As far as is known, letters T through Y were never actually used.

This system lumped together tubes of all sizes and uses having the same number of elements ("D" included subminiatures and water-cooled items). It did not distinguish among vacuum, mercury-vapor, or gas-filled devices. Multiple-section tubes like the 2C51 or 2G21 were simply scored by the most complex section.

The code had largely faded from use on tubes by about 1950, in favor of simple four-digit numbers. However, the arrival of the transistor gave it new life. The first number was redefined: "1" had always applied to diodes, "2" now covered triode transistors, "3" described tetrode or dual-gate transistors, and "4" or "6" referred to multi-lead devices like diode-phototransistor optoisolators. The "1N" numbers reached about 1N6300; "2N," about 2N6800; "3N," about 3N260; "4N," about 4N50, "6N," around 6N140. Even so, a changeover to nonregistered (manufacturer-assigned) numbers slowly occurred, and was largely complete by the time integrated circuits arrived.



AMATEUR RADIO

EDITED BY
KEN GARDNER, W2BGN
42 Oakdale Ave S. New Hartford, NY 13413
All correspondence requires SASE for reply

MY CONVERSATION WITH FESSENDEN

Bill Orr, W6SAI
48 Campbell Lane, Menlo Park, CA 94025

The year was 1932. Like it or not, I was going on vacation with my folks to Bermuda. Nertz! I would much rather stay home, practice code and get ready to take my amateur radio license.

But no. Mama wasn't about to let her 13-year-old stay alone and play with dangerous radio gear that might electrocute him! So off I went, scowling, to Bermuda. Wisely, I had copied the names and calls of the six Bermuda hams from the Callbook. I would meet them and perhaps get on the air from VP9-land!

Alas, it was not to be. Armed with a phone book I sprawled on the floor of the hotel room and called them, one after another. One was no longer licensed. The phone did not answer at two other houses. One seemingly had no telephone at all. But I was lucky on the last call to VP9F, Professor R. A. Fessenden. A female voice answered the phone and, after a pause, agreed to call the Professor to the phone. At last I had reached a Bermuda ham!

There was a very long wait. Was the phone line dead? I listened intently. I could hear faint voices. Finally, after an eternity, a loud voice barked, "Yes. What do you want? Who are you?"

I began to think this was not such a good idea after all. The Professor sounded like a terror. But I gave my name, explained I was on vacation and that I would like to meet a real Bermuda radio ham and see his station.

There was a deadly silence. Then the phone exploded. I turned beet red as the voice roared, "*YOUNG MAN*! Do you know I climbed six flights of stairs from my boat dock to answer your damn-fool phone call? I am NOT a radio amateur, I am a Scientist! Goodbye!"

The line was dead. The words were seared in my brain. I remember them to this day. All thoughts of meeting Bermuda hams had vanished. As far as I was concerned, the trip was a total failure!

On a later trip, I finally met Alfred Redmond, VP9R, the Health Officer of the island. He welcomed me into his home, calmed my jumpy nerves with glasses of cool lime juice and invited me to work his rig, a 203A TNT oscillator, on 20 meters. My dreams had come true. I had met a VP9 and, in fact, had become DX myself, using Alfred's station!

That was the beginning of a long friendship. I visited VP9R many times, sent him hard-to-get transmitting equipment and regretfully saw his name and call listed in "Silent Keys," just before World War II.

I've not been back to Bermuda for 50 years. But I'll never forget the "welcome" I received, or my telephone call with Fessenden!

1929 QSO PARTY
'29 VINTAGE EQUIPMENT

Wednesday-Thursday, October 17-18, 7-12 PM EDST, approximately 3590 kHz.

The 1929 QSO Party is open to members using transmitters of 1929 or earlier vintage, of the self-excited type: Hartley, TNT, etc. The power input must be less than 10 watts. Participants are encouraged, but not required, to use straight keys and regenerative or other vintage receivers.

Keep your power below 10 watts. Send "CQ AWA." Make as many contacts as possible with other members. Exchange RST, power input, and year vintage for the transmitter. Send a copy of your log, citing equipment used, to Bud Hall, K2LP, Box 974, Eastham, MA 02642.

1990 AWA CONFERENCE REPORT

Bill Fizette, K3ZJW, Conference Chairman

AWA's 29th Annual Conference took place at the Thruway Marriott Hotel outside Rochester on September 12-15. About 825 attenders registered, comparable to last year's total. Foreign guests came from Austria, Brazil, Canada, France, Germany, Italy, the Netherlands, the U. K., and Sweden. This was our first event away from Canandaigua in years, but in accord with earlier annual conferences at such places as Holcomb; Dearborn; Cincinnati; Philadelphia; East Greenwich, Rhode Island; and Washington. The newer, larger hotel proved to be highly satisfactory for the large attendance typical of recent years: the relief from crowding was welcome, the staff worked hard for us, and food service for the banquets was improved.

The special theme for this year, with the 100th anniversary of Edwin Armstrong's birth approaching, was the inventor and the innovations that he brought about. This was reflected in conference sessions and in the special categories in the Equipment Contest.

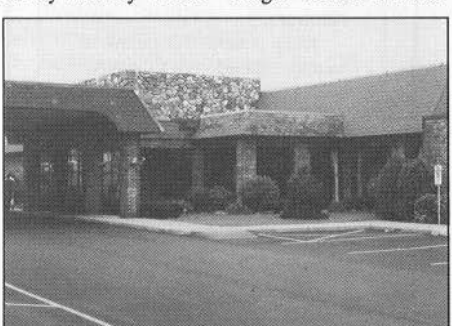
Events began on Wednesday with the **flea market**, which ran up to Sunday morning, and an afternoon at the **AWA Museum**, about 30 minutes away. The three-acre flea market (lighted, paved, mud-free) was packed with vendors at midweek, tapering off toward a rainy Saturday. Over four days there is rotation of both buyers and sellers: it's really two or three flea markets back-to-back, and a scan of the tables twice a day is needed to spot new prizes that turn up.

Thursday started with a special **bus trip** to the Museum for the convenience of those not wishing to drive, followed by the **television auction** conducted by Harry Poster. A selection of receivers, literature, and parts went to new owners. In the afternoon, the **Key & Telegraph Workshop** was led by Murray Willer. Roger Reinke showed slides of a remarkable assortment of camelback keys, Lou Moreau discussed key history in general, Gil Schlehman showed pictures of semiautomatics, and Murray covered some collectable keys that are still within reach of the beginning collector. Next, in the **"Goat Glands and Border Blasters"** session, Dave Moore and Wendell Wiborny presented the story of Dr. J. R. Brinkley and broadcasting across the Mexican border. John Caperton, long-established historian and collector, covered **the superheterodyne receiver**, Major Armstrong's landmark development. Then, in the **Broadcast Receiver Workshop**, Mel Comer conducted a session on collecting broadcast receivers with a special presentation by Ed Lyon on restoring Catalin sets. After dinner, Museum curator Bruce Kelley gave a slide talk, **"An American Inventor,"** on the life and inventions of Armstrong.

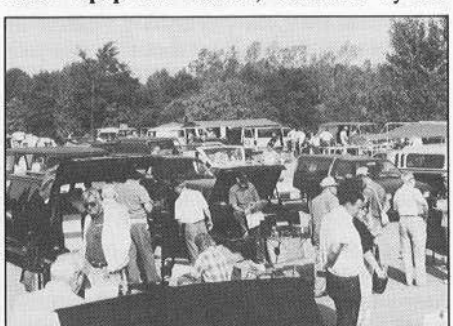
Friday opened with the **annual sightseeing excursion**, this year to Canada. The group toured Niagara Falls on the extra-scenic Canadian side and had lunch in Ontario. Meanwhile, Bruce Roloson served as all-day auctioneer for three sales benefitting the Museum: the **vacuum-tube auction**, a special **paper-collectables auction**, and the **general auction**. Judging took place simultaneously in the **Old-Equipment Contest** organized by Ralph Williams.

That evening, the **contest-awards dinner** honored the winners (see the listing on page 27). As a special feature, Garry Yoggy, history instructor at Corning Community College, produced an **old-time radio show**: a stage version of the classic "Fibber McGee and Molly" program, with actors and sound-effects equipment furnished by the Elmira Little Theater.

Saturday's activities began with the **Communication Equipment Auction**, conducted by Ed



New year, new hotel.



Vigorous activity in the flea market.

Gable, K2MP. A healthy selection of comm gear, much of it in excellent shape, was available and went for respectable prices reflecting the quality. At noon, after the **ladies' luncheon**, Bob Schaumleffel presented his multiprojector slide show on Malaysia. In the afternoon, the **amateur radio seminar** conducted by Bruce Kelley, W2ICE, reviewed the 1990 OT Contest. He replayed the tapes of a CW copying-through-QRM contest from a generation ago and a high-speed Morse message-handling demonstration from the 1968 Conference. Then Tom Lewis and Morgan Wesson showed preview excerpts from the upcoming PBS video production **"Empire of the Air,"** featuring interviews with such pioneer AWA members as Gertrude Tyne. Ross Smith finished the afternoon's presentations with slides covering the 1984 and 1989 BVWS-AWA joint meets in London, showing a wide variety of British radio treasures.

The Conference concluded with **the banquet**, MCed by Bruce Roloson. A high spot of the event was presentation of awards. **Marshall Etter**, W2ER, received the **Cundall Memorial Award** for his winning results in the Old-Time CW Contest. As announced by Gilbert Houck, **Morgan McMahon**, N6VY, was chosen for the **AWA Houck Award for Documentation** for his production of three important books on early radio. Bruce Kelley reported the choice of **Chuck Dachis**, WD5EOG, to receive the counterpart **AWA Houck Award for Preservation**, in honor of his collection of Hallicrafters receivers. Bruce Roloson presented the **President's Award** to **Richard Neidich** for his multi-year efforts in providing the automation system for Conference record-keeping. The **Taylor Television Award** went to **Arnold Chase**, announced by Ross Smith. Barney Wooters represented **Gertrude Tyne** as recipient of the **Tyne Tube Award**. Finally, the new **BK-OTB Award** went to **Jack Kingman**, W4JT, announced by Ludwell Sibley in honor of the former's article in the November 1989 issue. Featured speaker was Tom Lewis, of Skidmore College, on the nontechnical aspects of Edwin Armstrong's life and inventions as described in his planned book.

Conference leaders this year were Lauren Peckham as Program Chairman and Bill Fizette as Conference Chairman.

Conference organizers Fizette and Peckham.

Old-time network radio recreated.

TELEVISION AUCTION

Harry Poster, Auctioneer

Admiral 21" bakelite table set 17
B & K 1096 Analyst flying-spot-scanner test generator 12
Crosley 10" bakelite, ca. 1949 15
Du Mont backlighted store sign, 18" wide 60
GE '60s B & W portable, working 6
Hallicrafters T54 7", ca. 1948, w/literature 110
Midland "TV monitor" radio 3
Motorola TS-14B 10" table set, 1947-48 33
Philco 19" portable 5
Philco sweeper/scope, wkg. 5
RCA 17" solid-state color set (modern) 1
RCA 8" personal portable, mid-50s, no sync 19
RCA antenna table for 630, good 12
RCA T100 metal case, ca. 1949, not wkg 52
Sony 5-303W Micro-TV (2), 1 wkg, 1 not, w/carrying cases 30
Sparton T100 mirror-in-lid, 1948-49, scruffy 10
Tele-Aids for 1954 models, 1.5" stack 5
Tele-Aids for 1954 models, 2" stack 7

TUBE AUCTION

Bruce Roloson, Auctioneer

Amperex HF-100 (3) 22
Amrad 'S' 25, 25
Arcturus Blue 127 14
Arcturus Blue 26 (1), 28 (3), good fils. 65
Arcturus Wunderlich B (2), NIB 105
Atwater Kent 607 35
Audion 70
Audiotron, double-filament 85
De Forest
Audion VT836739, open fil. ... 29
Audion 170
Audion, fil. open 375
Audion, original 650
DV-01A (2), good 45
DV-2 w/can 40
VT-21, fil. OK 120
Fleming Valve replica, W6IS ... 75
GE CG-1162 (2) 60
GE VT-4-C (4), in mil. case 40
Hytron 864, tested OK 14
ICA TV scanner tube, looks new 180
Kellogg 401 (3), good fils. 25
Lamps, carbon-fil., small, ~35 5
Lamp, infra-red, 1920s 6
Lamps, Edison 10 watt 113-V (2), 20-watt 110-V (1) 14
Majestic G-59-B (2), G-55-S (2), NIB 15
Marconi V24, in original box, good fil. 70
"Metal" Radio Secteur AC, good fil. 140
Misc. (88) 24
Misc. miniature (500 to 1000) .. 10
Misc., 1940s to 1970s, ~150 .. .. 9, 15, 11, 20, 10
Misc., ~400 58
Moorhead Marconi/De Forest VT, fil. OK 50
Musselman 3VA, w/factory specs 26
Myers-Canada Audion, new with mounting hardware 80
Photodetector (?) 21
QRS Red Top in original box ... 28
"R" Valve repro. 65
RCA 3E29 (2), NIB 2
RCA 10, new 10
RCA UV-199 brass, tip, good .. 19
RCA UV-201A brass-base (2), good fils. 25
RCA UX-199, NIB, good fil. 9
Rectar R-1 (1), UV-200 (3), all brass-based & tipped, good 30
Recto-Bulb 6EX 10
Sodion D-21 25
Sylvania 17DRP4, for Predicta ... 2
Large transmitting: De Forest 560, 203A, etc. 80
Telefunken RS-5 350
Telion TV receiving lamp 125
Tuning eyes (6), fils. OK 24
UF16 (2), good fils. 65
UV-199 (2), brass-base, one with tip, good fils. 34
UV-201 w/stand 10
UV-201As (6) 16
UV-201As (10) 60
UV-201A, brass-based, no tip (4) 40
UX-199 (2), good fils. 21
Variety - UV-200, C-299, C-301A, 112A, etc. 26
Western Electric
203-B, good fil. 35
205D, 398A, 350B, & 416B 75
211-E 11
216A 26
216A, 205D, fils good 40
416B, new 11, 7, 7, 5
725A magnetron, NIB 22
Westinghouse
Aeriotron WR-21, good fil. 50
861 20
UT-2 ..... 40, 45
WR-1 50
Zenith 12A 1

LITERATURE AUCTION

Bruce Roloson, Auctioneer

ABCs of Wireless Telegraphy, The, Trevert, 1911 Ed. 55
Alexander Popov, Inventor of Radio, Radovsky, in English 160
ARRL Radio Amateur's Handbook
1926 Ed. 50, 90
1927 Ed. 36, 44
1930 Ed. 50
Atwater Kent Service Manual, Vol. 2 40
British Wireless, two-vol. set 45
Call Books
Amateur Radio Stations of USA, 1925 9
Commercial and Govt. Radio Stations of U. S.
1922 19
1929 13
Consolidated Radio Call Book, 1922 ..... 29, 34
Clapp-Eastham Catalog S, ca. 1919 90
Conqueror of Space, Life of Lee de Forest, Carneal 35
De Forest Equipment Cat. H, post-WW I 100
Electrical Experimenter (one, 1919), Wireless Age (one, 1920) 30
Electrical Experimenter (two, 1914 & 1917) 22
Electrical World, 1897, bound, poor cond. 15
Gernsback Radio Encyclopedia, 1927 Ed. 25
Hawkins' Electrical Dictionary w/dust jacket 10
Handbook of Technical Instruction for Wireless Telegraphy, Hawkhead & Dowsett 42
High Frequency Manual, Handbook for Electricians, ABC Telegraph Code 29
Home Radio, The, 1922 17
Lefax Handbook, 1924 13
Manual of Radio Telegraphy, Robison, 1919 Ed. 50
Old Wires and New Waves, Harlow, 1936 45
Operators' Wireless Tel & Tel Handbook, Laughter, 1909 12

Philco Service Notes, Sams' Photofacts 6
Philips Valves, Radiotron Designer's Handbook, Principles of Electricity Applied to Tel. & Tel. 15
Popular Elect., Sams, Manuals (two big boxes) 150
Radio Boys (4), Tom Swift (2), Misc. (2) 45
Radio College of Canada, 2 Books, Canadian Radio Schematics 70
Radio Craft (4) 20
Radio Engineering Handbook, Henney, 3rd Ed. .2
Radio Manual, The, Sterling, 2nd Ed. 14
Radio Measurements, Bureau of Standards Bulletin 74 8
RCA 8 Lessons, 1932 ..... 5, 5
Rider's Manual TV-2 7
Rider's TV Repair, Vols. I and II 30
Rider's, Vol. III 19
Testing Dymamos and Motors, 1914 5
Thermionic Vacuum Tube, van der Bijl, 1920 15
Tom Swift & His Television Detector, Appleton. 6
Wireless Telegraph Course, Marconi-Victor, six records and manual 75
Wireless Telegraphy and Telephony, A. P. Morgan, 1922 10
WWJ, The Detroit News, 1922 15

GENERAL AUCTION

Bruce Roloson, Auctioneer

AMPLIFIERS

3-tube res.-coupled, w/box 45
AMI Audio Model AA 35
Magnavox 3-Tube (panel only) .. 5
Multi-Audi-Phone 130

ADVERTISING

Atwater Kent wood sign 400
Eveready sign, flashing 650
RCA "Nipper," Chalkware 65

HEADPHONES

Brandes, three pair, two exc. 10
Brush crystal, NIB (2) 40

WIRELINE GEAR

Buzia key, Australian 50
Edison Western Union stock ticker, less glass 1,500
Kellogg 21168-A desk set 30
Kellogg CTPFF wall tel. 225
McElroy Deluxe Mac Key 45
Misc. relays-sounders (4) 60
Peerless Signagraph Omnigraph with tapes 10
Stromberg-Carlson WW I "field buzzers" (2) 75
Tel. receiver, single-pole 170
WU 1-B polechanger key 11
WU 1-B sounder, 400 ohm 8

MICROPHONES

Astatic floor, like D-104 40
Electrovoice 726 45
"Little Wonder" in box 10
Western Electric 610B 26

MISCELLANEOUS

B-batt. elims., Tower, Valley 30
Batteries, Burgess, old: 3-A, 2-B, 1-C 20
Bodine motor-gen., small 40
Branston 3-coil mount and 12 honeycomb coils 32
Coils, plug-in, ca. 20 26
Crystal detectors (5) and 1 crystal tin 55
De Forest crystal detector 100
Edison battery-oil bottles (3) and early motors (3) 40
Knapp 29 5-volt "A" supply 20
Lamp cord, cloth, 250 feet 33
Lepel spark gap 40
Loop antenna, floor model 38
Radiola IX battery box 35
Remler slide-tuner coils (2) 65
Rotary spark gap, unknown, with 1/4-hp motor 200
Trumbull antenna switch 10
Vacuum capacitors (2) 18
Wilcox-Gay 3C10 combination recorder 14
Zenith Wavemagnet loops (2) ... 5

RECEIVERS - CRYSTAL

Adams-Morgan Junior loose-coupler set 150
Bethlehem Radio Corp. "Crystal Dyne" 230
Crystal sets, 1950s (3) 33
Ericsson, with headphones 360
Gecophone, with phones 500
Martian, original 210
Philmore Junior 35
Phonia Paris, with phones 650
Snyder Inc. Little Giant, box .. 350
Unknown crystal set 95
Westinghouse DB detector 375

RECEIVERS

American Bosch Amberola 16 battery set 21
American Bosch 610A2 5
American Bosch 430 tombst. ... 35
Arborphone 34
Atwater Kent
19, wrong audios 200
19, good audios, tags 300
4445 breadboard 700
20C 46
35, w/tubes 20
Automatic Radio 6
Beehive Gloritone 60
Bendix Air Marine BC 12
Bendix Model 526B 25
Bremer-Tully Counterphase w/manual 60
Leutz 7-tube superhet and tuner 1,100
Crosley
JM8BG hybrid xstr "book" ... 200
Trirdyne, no tubes 55
50 130
51 ..... 110, 130
V 160
De Forest
P-500 350
F-5 130
T-200 mod., not right knobs. 300
D-10 reflex 500
Parts set 110
Delco R1126 60
Dewald K-701 transistor 19
Duck 4885 34
Echophone 15? cath., exc. 420
Emerson
U6D mini-cath., exc. 120
222B 5
520 Catalin 130
Eveready Model 2, 1928 50
Fada 3-dial neutrodyne 36
Federal H-10-60 Orthosonic 30
Firestone CAM 9
Franklin cathedral, solid-state. 16
Freed-Eisemann
NR-5, tubes 45
NR-57 75
Neutrodyne, 5-tube 40
Transco., French 5-tube 170
Freshman Masterpiece 47

Freshman Masterpiece, internal speaker....70
Garod RAF....21
GE A-82, good....130
Grebe MU-1 Synchrophase w/battery box....310
Grebe....120
Grebe AC-6....85
Grunow 6B Teledial....40
Grunow 700-series Deco tombstone....160
Hammarlund Hi-Q 6....16
Hoffman solar transistor and OTBs....100
Int'l Radioette 2-tube w/box..250
Kellogg RFL, Kellogg tubes....75
Kennedy 281 and 521....850
Kolster 6-J, good....24
Luxalu 5-tube mirrored....260
Motorola 1935 Auto....17
Music Master 100....30
Music Master 60....70
Norden-Hauck superhet....460
Nordmende Bambino xstr....26
Philco
16B....130
20....160
37-620....34
38-62....21
650....40
Junior cathedral....65
"Veep" xstr, w/box, 1959....26
Porta-Baradio bar, w/glasses...75
RCA
5Q55 BC-SW....55
8BX-6E....12
Radiola 18....20
Radiola 25, tubes, no loop....60
Radiola III-A....130
Radio-Matic coin-operated....28
Radiocraft MR6....1,500
Radiocraft tuner....650
Regency TR-1 with case....110
Sentinel 6618 cathedral....70
Supreme (Los Angeles) crystal and 2-tube amp....80
Thompson 5A Neutrodyne....140
Trav-ler Portable with original batteries....180
Tresco det. and two-stage....360
Truetone, exc....41
Tuska 224....290
U. S. Apex "screen grid" cath....85
U. S. Apex cathedral....85
Westinghs Aeriola Sr....120, 150
Zenith
33....15
69-220, good....100
6D614....30
6G801, broken door latch....28
R600 Transoceanic....25
Super VII....130
T600 Transoceanic....21

SPEAKERS

Atwater Kent Model M Horn..60
Atwater Kent Type E....28
Crosley Musicone, NIB...100, 110
Crosley speaker stand....40
Horn, morning=glory, phono..55
Majestic horn, good driver....70
Radiola 100A....15
Stewart-Warner, dancing-girls design....130

TEST GEAR

Bunnell galvanometer, WU....525
Eico 667 tube tester....10
GE YNA-4 oscilloscope....11
L & N precision pot....40
Scope, TS-100/AP, spare CRT 12
Supreme Std. Diagnometer....36
Measurements 95 grid-dipper..40

COMMUNICATIONS-EQUIPMENT AUCTION

Ed Gable, K2MP, Auctioneer

Collins R-388/URR, forklift bash in rear, restorable....100
Collins 51J-4, clean, bandchanger and dial cord bad, book....180
Gonset Super Six conv., exc....10
Hallicrafters
HT-9, exc., book, D-104 mic. 140
S-15, lightly mod., spkr, exc....75
S-20R, good....40
S-22R, good but wrong knob..50
SX-24, VG, book....65
SX-28s
Fair, no bottom, shield gone 20
Good....35, 35
S-36A, good....30
S-38C, exc....32
S-38C, exc., w/book....35
S-40A, exc....55
SX-43, exc., book....75
S-76, good....70
S-96, exc....65
SX-99, good, book....35
SX-100, exc....125
5R34, VG....30
Hammarlund HX50 SSB, exc...75
Haynes RSR Clipper, 3-1600 m., plug-in-coil, restored,....110
Heathkit Seneca, good....20
Homebrew AM xmtr, small, good....25
Homebrew plug-in-coil rcvr, VG....35
Lysco mobile xmtr, good....14
Lysco 25-W AM mod., exc....20
Military
BC-348, heavy mods....21
BC-779, Howard-made, book, PS, good but wrong knobs....65
Command Set: BC-458 orig., MD-7 orig., BC-453 mod....75
SCR-522, less case....3
T-74/CRT-1 Gibson Girl transmitter, fair....15
Mitchell Airboy Senior transceiver, good....25
National
HFS, VG, coils, book, no PS 105
HRO. 1935, mod. internally, 4 coils, no PS, *shipping crate*....90
NC-57, fair, book....35
SW-3s
Exc., 4 pairs coils, PS....360
1 shell, 1 restorable, 2 coils 130
Pair of coils only....42
SW-5, cover missing, 11 coils, AB supply, good, wkg....270
NC-173 with tar flow, good otherwise....25
RCA ACR-155, good, book....60
Realistic DX-300, exc....105
RME
84, excellent....55
4350, exc., w/book....45
VHF-152A, fair....10
Silvertone Precision Series 3 (Howard), good....95
Unidentified (USCG trainer?), exc....45

More photo coverage of the Conference will be in the February OTB.

Last-Minute Silent Keys

Paul Andrews, 90, retired GE engineer.
Ivan Coggeshall, retired engineering VP of Western Union.

OLD-EQUIPMENT CONTEST

Ralph Williams, N3VT, Organizer

Class 1 - **Armstrong and Regeneration**

First: Lauren Peckham, Equipment Used by Armstrong (superregenerator demonstrated to Westinghouse, 1921; RF amplifier from Paris lab, WW I; replica superregenerative receiver)
Second: Ross Smith, Superregenerator
Third: Peter Yanczer, Regenerator with Amp.
Special: Luther Schaeffer, "Armstrong Blooper"
Special: Andre' Chompret, Radio Blocs Brunet six-module set, 1921

Class 2 - **Armstrong and the Superheterodyne**

First: Tolbert Prowell, Prototype Houck Second-Harmonic Superhet (operable)

Class 3 - **Armstrong and FM**

First: Bruce Kelley, First FM Network Broadcast
Second: Floyd Jury, Alpine Tower (scale model)

Class 4 - **Armstrong, The Man**

First: Floyd Jury, Life Display
First: Mike Katzdorn, Armstrong Papers (10-sided flip display)
Second: Jerry and Marsha Simkin, Book Display
Third: Ralph Williams, Armstrong Honors

Class 5 - **Passive Receivers**

First: Jim MacKinnon, Hunt & McCree 1912
First: Robert Lozier, Western Electric Italiana
Second: Les Rayner, Hunt & McCree, 1904
Second: Scott McWilliam, Commerce Radiophone
Third: Will Jensby, Marconi Type A
Third: Ron Frisbie; Kodel, Vibrator Battery Charger, and Kodel History

Class 6 - **Receivers, One- and Two-Tube**

First: Robert Lozier, English Kolster-Brandes regenerator (operable)
Second: David Cheney, Northern Electric
Third: John Wiesner, Grebe CR-8

Class 7 - **Receivers, Three-Tube**

First: Jim Clark, Tecla ("Thomas E. Clark") detector and two-stage amplifier
Second: Robert MacIntyre, Canadian GE 93
Third: Stephen Short, Kennedy V

Class 8 - **Receivers, Four- and Five-Tube**

First: Ross Smith, Silver-Marshall "Round the World Four"
Second: David Peckham, Radiodyne WC-5
Third: Ron Lawrence, Zenith 4R
Third: Clay Seidel, Franklin Treasure Chest
Special: H. K. Ruhl, Freed-Eisemann NR-405 (5-tube set from radio-phono)

Class 9 - **Receivers, Six Tube and More**

First: Les Rayner, Norden-Hauck DX-5
Second: Ernie Hite, Radio Receptor "Receptrad" glass-cased custom-built eight-tube set
Third: Conrad Spivey, Marti set and Kellogg-tube history
Third: Vernon Oehlke, Federal 61
Special: Billy Richardson, Haynes-Cockaday-Silver 4-unit superhet (operable)

Class 10 - **Spark Transmitters and Artifacts**

First: Glen Fritz, Arc Telephone Transmitter and 500-Volt Motor-Generator Set

Class 11 - **Tube Transmitters**

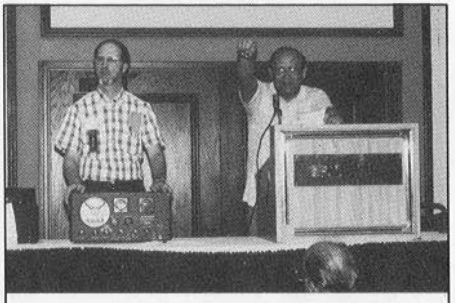
First: James Miller, 160-Meter (46s, QST, 1932)
Second: Parker Heinemann, Collins 4A (46s)
Third: Edward Waite, 1928 Push-Pull (852s)
Third: Bob Mattson, Hartley (210, QST, 1928)

Special Display

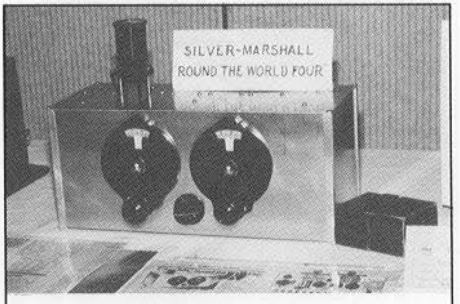
Philip Taylor, Tuning-Eye Tubes

Display Award (for Best Presentation): Jerry and Marsha Simkin
Elle Craftsman Award (Best Homemade Receiver): Lauren Peckham
Matlack Transmitter Award: Bob Mattson
Eunice Thompson Award (Best of Show): Mike Katzdorn

Judges: Al Bennett, Geoff Bourne, John Caperton, Charles Days, Alan Douglas
Administration: Ruth Drake, Elinor Williams, Ralph Williams



Chuck Bliley and Ed Gable move an SX-28.



Ross Smith wins again.

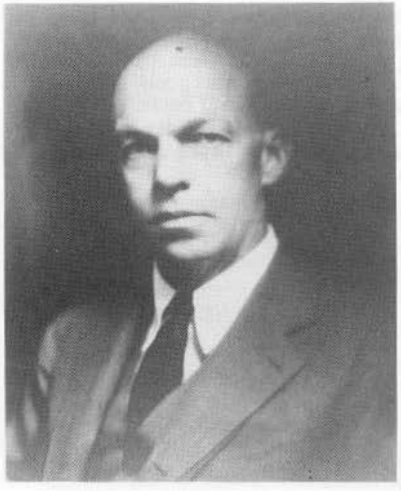
100TH ANNIVERSARY OF ARMSTRONG'S BIRTH

As commemorated recently at the Rochester conference, December 18 will mark the 100th anniversary of the birth of Edwin Howard Armstrong, an inventor little paralleled in the history of technology. This one individual brought us the regenerative detector, the superregenerative detector, the superheterodyne receiver, frequency-shift keying, and frequency modulation.

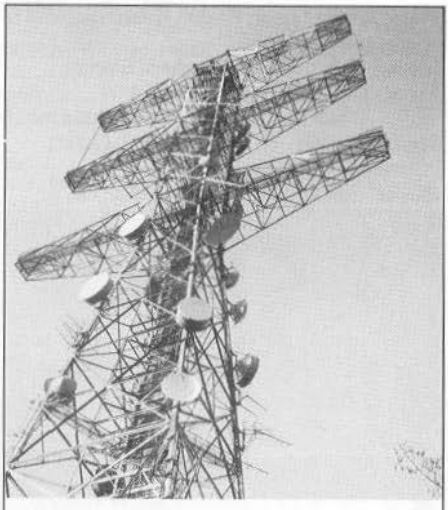
These were utterly basic inventions, not mere improvements in detail. Better yet, Armstrong saw them through to actual use: the difference between *invention* and *innovation*.

There is an odd quality about his IRE paper on the functioning of FM and his field tests of VHF broadcasting (Proc. IRE, May 1936, pp. 689-740). The whole concept of FM transmission and reception is explained in words, with the aid of a few simple vector diagrams and graphs. The entire discussion is conversational, intuitive, devoid of the usual mathematics. Armstrong - *Dr.* Armstrong - had the mathematical tools to describe the subject, but chose to talk the reader through in a rather successful way. The integrals and Bessel functions came later, and provided their particular value, from the pens of others. [LAS; photos: AWA Museum and Bruce Kelley]

Armstrong (seated, center right) during a Christmas party in the late Forties for employees of his experimental FM station KE2XCC-W2XMN-WFMN. Photo given to AWA by Perry Osborn, one-time chief engineer of the station.



E. H. Armstrong.



The W2XMN tower, still in use.

WESTERN ELECTRIC "D-SPEC" TUBES

Western Electric made many tubes identified as D-xxxxx. These were not listed in the WECo commercial catalogs, were rarely advertised, and are not covered in Tyne or the other usual sources. They were generally introductory models pending wider use, or interim improvements or modifications of existing products. As such, they were quasi-experimental. Here are the known types, the regular types to which they are related, and their known uses.

D-79509 205B with a different base.#

D-79510 Ionization manometer (vacuum gauge) with soft-glass bulb. Apparently looks like a tennis-ball repeater tube, but with an eight-inch section of glass tubing out the top.# >

D-79512 Hard-glass version of D-79510.#

D-80039 The 211D as produced for the U. S. Army Signal Corps, its VT-4B.*

D-80050 A coding of the 215A for the Signal Corps, its VT-5.*

D-80777 Ballast tube.#

D-85715 Similar to the 243A 2-kW double-ended water-cooled triode, but with a different base and lead glass instead of Pyrex.*

D-85716 Similar to the 240A 10-kW triode; changes as for the D-85715.*

D-85792 A high-insulation 102E, superseded by the 102G.*

D-86326 A high-insulation 101D, discontinued after production improvements in the 101D.* Used in input stages of the sending and receiving line amps of the C2 three-channel open-wire carrier telephone system. This system, modified for six channels, was applied to the San Pedro - Catalina Island submarine cable in the late '20s.

Early D-91143.
Balaton photo

D-86327 A high-insulation 104D, discontinued after production improvements in the 104D.* Used in push-pull parallel in output stages of C2 line amps; also, optionally, in the 22A2 telephone repeater.

D-86737 A 211D with reduced grid spacing, presumably for higher transconductance, recoded as 248A and used in low-level stages of the 5C 5-kW broadcast transmitter.*

D-87491 A unbased diode voltage regulator with tungsten filament (7.75 V at 1.65 A).*

D-87722 An unbased 231D used in the 1A Pilot Channel. The latter was probably an early transmission-level regulator like the 2B Pilot Channel for open-wire carrier systems).*

D-88057 Like the 212D but with fewer (1/2) grid turns.*

D-88526 Like the 212D but with fewer (23/39) grid turns.*

D-90278 Medium-voltage grid-controlled argon gas rectifier like 269A.#

D-90279 Medium-voltage grid-controlled argon gas rectifier like 256A.#

D-91143 101F with UX base and "S" or "ST" bulb, not "tennis-ball" style.#

D-91144 102F with special base.#

D-92437 Receiving triode.#

D-92321 Recoded as the 259A, a two-volt heater-type tetrode.

D-94044 Selected 264A 1.5-V triode.#

D-94230 Selected 231D 3.1-V triode, with bayonet studded base like 215A but 239A-size, ca. 1925.#

D-94341 Selected 224A five-inch CRT.#

D-95954 "AEO-lite," used by Movietone News.#

D-96412 Replaced by 294A small pentode.#

D-96413 Like 324A, a rectifier similar to the 3B24.#

D-96415 Electrometer, replaced by 5674.#

D-96475 Space-charge electrometer tetrode, with "S" bulb having a novel 1-1/2" tubular extension on top for extra insulation of the grid lead.@ Roughly similar to GE FP-54.

D-96820 Low-capacitance 50-W power triode similar to 211D and 242B.#

D-96987 100-W triode, equivalent to 845.#

D-97004 Stroboscope discharge tube.#

D-97822 Selected 205D.#

D-98677 The 215A as produced for the U. S. Navy, its CW-38015.

D-99022 Cold-cathode tube.#

D-155023 Unbased phototube, 1" dia. and 1-1/2" high, with 360-degree annular field of view. Very similar or identical to the 932, a red/infrared photocell. Suspected of having been the detector in the prewar Signal Corps experimental infrared airplane detector.

D-156548 Small double-ended doorknob triode, similar to the 388A, good for 5 W out at 750 MHz. Used in 1A Radio Altimeter.$

D-156734 A 205D with silver-plated pins.#

D-157591 Like the 382A small doorknob triode

for audio and UHF use, as in the RA-1095 preamplifier of the 640AA condenser mic.#

D-157653 UHF diode in unbased "mushroom" style like 380A.#

D-157654 Replaced by 384A unbased "mushroom" pentode.#

D-158643 Replaced by 384A.#

D-158976 Related to 386A unbased "mushroom" pentode.#

D-159076 Phototube.#

D-159508 Like 381A: a 380A "mushroom" diode on an octal base.# Used as a feedback demodulator in the D-159511 transmitter of the 1941 Cape Charles - Norfolk VHF relay system.^

D-159509 Like 383A: a 382A "mushroom" triode on an octal base.# (See D-157591.)

D-159511 Filament-type pentode, like 366A but with grid cap.# Used in low-level modulator stages in the D-159511 transmitter - see D-159508.^

D-159512 Like 387A: a mushroom-style pentode with octal base and plate cap.#

D-159764 A dual numbering of the 703A/368AS doorknob UHF triode.#

D-159765 Like the 704A UHF detector diode.

D-159769 Like 388A doorknob triode.# (A sample is known bearing both numbers.)

D-159778A Thyratron.#

D-159780 Like 705A vacuum HV rectifier.#

D-159781 Like 356B 50-watt VHF triode.#

D-160127 Metal-cased receiving SHF triode like 708A.#

D-160206 SHF receiving triode like 1272Y or 708A.#

D-160573 UHF transmitting oscillator, also numbered 1301M, similar to 708A.#

D-161145 UHF transmitting oscillator, also numbered 1325M.#

D-161714 Grid-controlled gas rectifier.#

D-161831 Grid-controlled gas rectifier, same as the Army VT-279, GY-2, and 1278/GY-2.

D-163876 Grid-controlled gas rectifier, also numbered 1374GY.#

D-164694 Small klystron, also numbered 1280CT, replaced by 2K40.#

D-164713 UHF transmitting triode oscillator.#

D-164714 Like 7C22, a large twin UHF oscillator triode.#

D-167158 UHF oscillator, also coded 1289CT.#

D-168535 Cold-cathode gas-triode relay tube.#

D-169618 Modified 723A/B 3-cm klystron.+

D-170135 Mercury-cathode series-gap radar pulser, also numbered 1B42.#

D-170573 Klystron, also numbered 5649, replaced by 5981.#

D-171089 Like 7C22 (D-164714) but shorter.#

D-172733 Tunable magnetron like QK185+.

D-176627 Klystron, also numbered 5650, replaced by 5981.#

D-178461 Selected 397A/2K56 4-GHz klystron, used in early FM terminals for TD-2 microwave system; replaced by 419A.

REFERENCES

> WECo ad in "Electronics," 10-31, p. 3.

* BTL drawing ES-452954, 4-22-29 issue.

Catalog of Navy Material, BuShips Section, Part II, Armed Forces Cross Index of Electron Tube Types, August 1950.

+ MIL-HDBK-213A, Military Handbook - Electron Tubes - Cross Index and Type Identification, November 1963.

@ Bell Labs Record, 11-35, p. 74.

$ WECo ad in "Electronics," 1-40, p. 61.

^ Proc. IRE, 2-45.

RECENT RADIO AND ENTERTAINER OBITUARIES

Charles Griffen, W1GYR

William C. Applegate, 60, WKBN-TV reporter; **Ralph Beaudin**, 62, former ABC Radio executive; VP and GM of Mitchell Broadcasting; **Harley P. Brinsfield**, 81, 32-year Baltimore jazz-radio show host; **Rev. Cecil Clifton**, 80, founder and general manager of WAVL; founding member of National Religious Broadcasters Association; **Arlen Craig**, 58, Seattle area stage performer; **Bob Danvers-Walker**, 83, radio & TV announcer, 1940-70 voice of British Pathe' newsreels; **Benton Deming**, 85, radio-TV personality; WTIC, WTIC-TV, WTHT; **Pauline Frederick**, 84, veteran broadcaster; ABC-NBC UN correspondent and NPR commentator; **Jay Gorney**, 93, songwriter, "Brother Can You Spare a Dime," etc.; **Albert A. Grobe**, 81, production mgr, news head, and news announcer, WQXR, for 30+ yrs; **Wallace Haynes**, 84, sound-effects editor of "Fantasia," etc.; **Paul H. Hershey**, 62, newscaster on WLKF, WEZY-FM; **Irving Hunter**, 80, Maine broadcaster on WLBZ 45 years; **Francis R. Kirton**, music dir. of CHRE-FM, St. Catherines, Ont.; **Roland L. LaLanne**, 82, broadcast technician for WTHT, WHCT-TV & CBS network; **Theodore J. Lydecker**, 81, pioneering dir. of special effects; with brother invented Lydecker wire illusion of flight to Captain Marvel; **Lois R. Marsh**, 74, TV-radio personality; KSD-TV, KMOX-AM & KWRE; **Harold Moss**, 40s, Pres./CEO of WTWS-TV; **John Quackenbos**, 73, retired director of GenRad, Inc.; **Michael Raffetto**, 91, radio actor (One Man's Family, I Love a Mystery); **Virgil C. Roberts**, 70, engineer, WLRN-FM-TV, VOA; **Albert Rose**, 80, inventor of the image orthicon TC camera; **Elton Rule**, 72, president of ABC-TV 1968-83; **Byron F. (Sid) Ryan**, 89, pioneer sound tech. at Western Electric and Warner Bros. 40-year career included development of sound eqpt. for the first sound pictures, including "The Jazz Singer."; **Bob Shea**, 70, 35+ yrs. as news dir. of KXOK-AM; **Jeffrey Sprung**, 50, ABC News executive; **Tony St. James**, 42, radio news anchor; formerly on KIQQ and KWIZ; **Brian White**, 59, Australian talk radio-news personality; **Rita Jacobs Willens**, 62, co-founded WFMT-FM; **Martin Workman**, 71, hosted KFAC-AM's daily "Luncheon at the Music Center"; **Charlotte Wright**, 67, former head of operations for Todd-AO Sound Service.

RESTORING OLD EQUIPMENT

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All correspondence requires SASE for reply

BUILDING A REPAIR STOCK OF TUBES

Restoring old equipment naturally requires a supply of "tubeware." The hints that follow will be helpful in assembling a stock for general repair use. The assumed starting point is a good-sized bag of loose tubes fresh from a flea market or auction: begrimed and unknown as to quality. The goal is a neatly organized set of reliable spares ready for use.

Clean-up. Inspection and washing come first. Miniatures and loctals, whose bases dry immediately without fear of electrical leakage, respond directly to a bath in dish detergent. The only risk is late-vintage miniatures from the smaller manufacturers, some of which are identified with white ink that washes away. Octals and other based types have to be held upside down during washing to keep water from running into the base. Flat beer-case cartons with paper toweling on the bottom organize the finished product nicely.

Miniatures and compactrons need a check for bent pins. Fingernails or a pin straightener are the preferred tools to correct any bending. The use of pliers is virtually certain to crack the glass.

Testers. Tube checking is the next step. The problem is to screen a lot of tubes fast, weeding out the truly defective ones. Testers come in three general classes. First are the highly refined mutual-conductance units (example: the old Heathkit TT-1) that give quite a sophisticated analysis. Unfortunately, their setup switches and adjustments are complex, making testing a couple of hundred mixed tubes a slow process. Second are the servicing-oriented testers of the mutual-conductance type. Of these, the I-117 military tester from WW II works well for tubes listed on its (1945) chart. The surplus TV-7/U unit is excellent for tubes designed up into the Sixties. Most civilian mutual-conductance testers are of this general type. The third class is emission testers like the Heathkit IT-17. These make a cruder test than the others but are quick and easy to set up.

Lest anyone place too much faith in tube testers: the writer once took a group of 201As, selected to represent a spectrum of quality from poor to excellent, and tested them on four testers of differing types. The results varied all over the map; there was only a vague correlation between readings on the different testers. The message: use a single tester, rely on it to catch the gross defects (shorts, gas, burnouts), but expect it to give no more than relative ratings of tube quality. *There is no other place in electronics where routine keep-or-replace decisions were made, based on a tester lacking a calibration control!*

Testing. The game now is to fight boredom: to reduce a slow task to as few motions as possible. The idea is to group the octals together, the 7-pin miniatures, the loctals, and so on; then to bunch up tubes of the same or similar types. With the tester set up for a particular type, one can breeze through all units of that type in quick time. This idea immediately leads to grouping all types having the same pinouts, for example the 6S(G-H-J-K-S)7 family or the 12A(U-V-X-Y-Z)7 group. Here it is possible to go between types by changing only the potentiometer(s) on the tester, not the pin switches. Or one can group by heater voltage: test the 6BA6s, then do the 12BA6s by simply turning up the heater voltage. Wisdom requires testing the lowest-voltage types first, to avoid the bitterness of blowing the tube with excessive voltage. A skilled user can deliberately read the tester chart out of sequence, getting the heater switches ready first so the tube is heating while the other settings are going on. With practice, one can do a hundred mixed tubes an hour.

In the Fifties, countermen in parts stores who spent their days testing whole TV-sets-ful of tubes had preheaters: a chassis with multiple sockets wired to apply six volts to all heater pins. This shaved a few minutes off the time to check a load of tubes, not a bad idea today for anyone expecting to test a lot of tubes often.

Further tests. Supplemental tests are sometimes necessary. The IT-17 tester shows "good" on 35Z5s and 35W4s even when the pilot-lamp section of the heater is open. An extra check with an ohmmeter is needed on these. Big rectifiers like 5U4s that test OK may arc-over when used at full voltage in a TV set; only set-testing finds these. Power tubes like 7C5s may consistently measure only marginal; it is helpful to check several of the same type to find the weakest members of the group. Used magic-eye tubes are usually dim; being nonessential to the operation of

the radio, they were rarely replaced during normal servicing. Again, comparison of several tubes will show which ones to discard.

Mystery Tubes. The identifying numbers on tubes sometimes become faint. Here the old repairman's trick of rubbing the tube on one's hair comes into play. The tube collects a light film of oil. Holding the glass up to the light then reveals the number by contrast. For exceptionally weak numbers, this test becomes much more sensitive if one strokes the tube with a finger, smoothing out the oil film. The writer once got a grocery bag of someone's "mystery" tubes at an auction; the hair-oil trick revealed the identities of most of them. This is far more effective than alternatives like breathing on the glass or wetting it with ammonia.

Tubes of the two-digit variety may be numbered almost anywhere: on the crown, on the side of the bulb, or on the base. With practice it becomes possible to guess the type pretty closely by inspection. The tube tester is the tiebreaker between look-alikes, for example the 2A7 and 6A7, with different heater voltages.

For hints on "restoring" tubes, see the Vacuum Tube column in the August OTB.

Defective old-time tubes have their uses. It is appropriate to write "dud" with an vibrating engraver on the base of a reject so that no one can be confused later on. The reject is then suitable for display purposes or use with a field-effect transistor hidden in the base.

Diversions. It is appropriate to check any metal tubes in the group for steel-stamped, not inked, type numbers. Numbers and manufacturers' names in the original few types were marked this way during the first months of production in 1935, so anything identified this way is a collectible. Tubes also turn up with "MR" stamped on the base. These were "maintenance and repair" items made for civilian receivers during the severe tube shortage of WW II. They were produced in a few common types, in limited numbers. Where a tube carries a glued-on label from a Thirties repair shop, one can carefully soak it off and save it for eventual display in a collection of such labels: a zero-cost additional hobby!

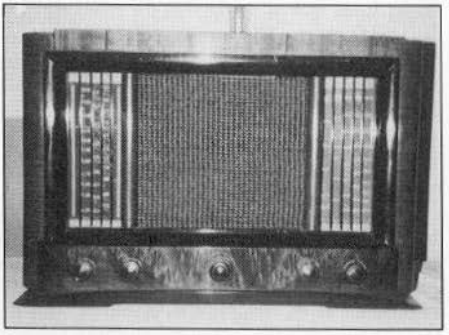
Storage. Boxing-up comes next. New white boxes are available from sources like Antique Electronic Supply. They sometimes appear in collector markets. Old boxes can be reused nicely by covering the type-number stamping with typist's correction tape of the 2/6" width, giving a fresh writing surface. A cardboard box of the 11" X 17" size used for xerocopy paper can be cut down to tube-box height. It then takes 196 miniatures or 96 octals, with a convenient slip-fit lid. With 3" X 10" spacers cut from thin slick poster board to keep the rows straight, a tidy package for storage results.

After the first few hundred items are sorted out, tubes resolve themselves into three classes, of decreasing value: the Valuable Repair Supply, the Flea-Market Sale Stock, and the Embarrassing Glut. One quickly learns that a bag of TV-set "pulls" isn't worth much. (How many 6SN7s can you *use* in a lifetime?) The flea-market stock can be sold off, slowly, if the tube boxes are labeled clearly and displayed in correct order. Jumbled into a shopping bag, they are unsalable. Miniatures have essentially zero value in the collector market, but have some draw at hamfests. Compactrons have negligible value anywhere.

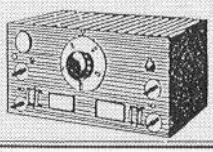
Duplicate Types. A remarkable number of tubes carry multiple numbers. This effect began in the Thirties with the 35/51 and 39/44 but really mushroomed toward the end of the tube era. Thus, an owner of a 6BS8 automatically has a 6BQ7A and a 6BZ7. These are multiple designators for the *same* item . . . a little like referring to "chicken wire" as "poultry netting"; they are not mere "equivalents." It has been possible, by comparing manufacturers' lists, tube cartons, and tubes themselves, to develop a list of 400-plus families of multi-numbered tubes. Too long to print here, it is available by sending a letter-size SASE to the writer at the address at the top of this column. It can help avoid stocking the same item under two or more numbers, as well as aid in fixing sets where the correct tube seems to be unavailable.

THE RIGHT GRILL CLOTH?

One of the problems in restoring receivers is correctly replacing perishable items like the grill cloth. The Philco 41-788 "Tropic" model pictured is an elegant 11-tube set with push-pull output, bandspread tuning on short wave, an RF stage, etc. However, its owner, Jan G. Collins, wonders if the grill cloth, as replaced, is close to the original pattern. Philco experts, or anyone having access to pictures of the 1941 line of receivers, are invited to contact him at 5850 Forestview Drive, Columbus, OH 43213-2112.



THE COMMUNICATION RECEIVER



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THE NAVY MODEL RAS RECEIVER: A THINLY DISGUISED HRO JUNIOR?

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A prime example of the high-quality communications gear produced for the U. S. Navy by the National Company before and during WW II was the Radio Receiving Equipment, Models RAS-1 through -5. This receiver, an offspring of the National HRO, was designed to meet a Navy requirement for a high-quality receiving station tuning continuously from 190 kHz to 30 MHz.

The RAS was impressive to see (or lift), with the receiver panel dominated by the HRO-style PW dial. Clad in a gleaming black crackle finish, with its four component units mounted in a 39-1/2" table rack, the assembled unit weighed in at 119 lbs. Included were the receiver, power supply, seven coil sets, and a Rola 8" PM speaker. The equipment required only an antenna and a 115-VAC power source for operation.

Aside from the apparent quality of National products of the 1930s, the features demanded by the Navy included copper plating of all steel parts, a separate output transformer for headphones, and sealed oil-filled bypass capacitors. The RAS was ruggedly constructed of the best materials and components of the day.

While this radio was produced for about five years, an RAS in original form is seldom seen. W3VVS, an authority on the set, gives us an overview of the set and its history. -K3ZJW-

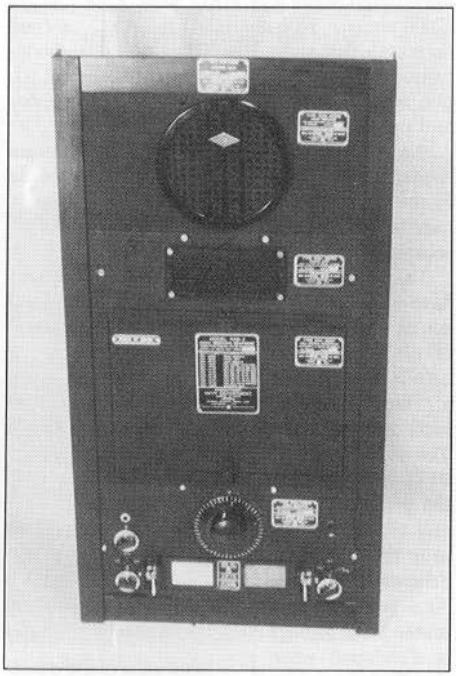
During World War II thousands of National receivers were manufactured for the war effort in many different configurations. One of the best-known at the time was the Model RAS.

In the late 1930s, the National HRO had found wide acceptance as a reliable communications receiver by the Civil Aeronautics Administration, the airlines, state police departments, and the military. However, the Navy questioned the need for the crystal filter for monitoring purposes. Further, the HRO did not cover important maritime frequencies.

Delving back into HRO history, in February 1936 the HRO Junior was advertised "for those who require the high performance of the Standard HRO but do not need its extreme versatility." The circuitry and mechanical details of the HRO Junior were identical to those of the Standard HRO (later termed the HRO Senior), but the lower priced Junior omitted the Lamb crystal filter and the "S" meter, and employed general-coverage coils with two amateur bands per set. The RAS bears a striking resemblance to the HRO, and at first glance is often identified as a "Navy HRO," but the RAS can better be considered an outgrowth of the HRO Junior design.

The RAS-1 was first made for the Bureau of Engineering of the Navy Department by the National Company for the prime contractor, the General Electric Supply Corp., Washington, DC, with a contract date of December 7, 1939. Subsequent contracts for Models RAS-2 through -5 were let from 1940 through 1943, with National becoming both the prime contractor and the manufacturer in 1943 for the Bureau of Ships.

The receiver was intended for use both at sea, where a 60-Hz source was readily available, and at shore stations, some of which still used 25-Hz



power. For the latter (for example, the Panama Canal Zone and parts of Hawaii), a 25-Hz power pack was provided. The set could even be operated with batteries, with the most economical power coming from a 180-volt B supply. (Nominal requirements are 240 VDC at 70 mA and 6.3 V at 3.4 A.)

The receiver circuit is essentially "HRO," but with important differences. There is no S-meter or crystal filter. The intermediate frequency is 175 kHz, versus the conventional 456 kHz. The seven coils provide continuous coverage from 190 kHz to 30 MHz, while the nine coil sets for the HRO cover 50 kHz to 30 MHz with a 430-480 kHz gap. Because of the differing IFs, RAS and HRO coils are *not* interchangeable. The RAS coil sets as issued consisted of matched coils, each with the same serial number, but sets from one RAS model can be used in any of the others. The only difference is in the thickness of the mounting plates, the early versions being assembled on 3/16" aluminum while the later models used 1/16" steel.

COMPLETE MODEL RAS EQUIPMENT

Radio Receiver	CNA-46080
Power Unit, 60-Hz	CNA-20090
Power Unit, 25-Hz	CNA-20089
Loudspeaker	CNA-49105
Loudspeaker*	CNA-49106
Mounting Rack	CNA-10036
Coil Container	CNA-10037
Coil Set, 190-450 kHz	CNA-47156
Coil Set, 450-900 kHz	CNA-47157
Coil Set, 0.9-2.0 MHz	CNA-47158
Coil Set, 2.0-4.0 MHz	CNA-47159
Coil Set, 4.0-7.0 MHz	CNA-47160
Coil Set, 7.0-14 MHz	CNA-47161
Coil Set, 14-30 MHz	CNA-47162

*Optional unit for table mounting, 10-1/4" W X 9-3/8" H X 7-1/4" D.

The output tube is a 6V6 (5000-ohm load impedance) while the HRO used a 2A5 or 42 (7000 ohms). With the HRO the AVC - second detector - first audio is a 2B7 or 6B7 dual-diode-pentode; the RAS used instead a 6F8G dual triode, which functioned as a triode-biased detector and an amplified delayed AVC stage.

An optional subchassis, the CKB-50142 noise limiter, became available in the mid-1940s. Made by the Mission Bell Radio Co. of Los Angeles, it used a 6SN7 and 6SQ7. Plugged into the 6F8G socket, it was left in place permanently.

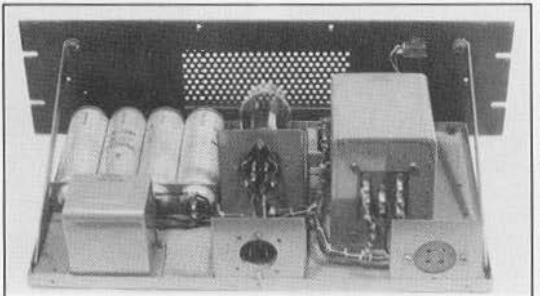
The first and second 175-kHz IF transformers have one-megohm swamping resistors connected across the full secondary windings, while the grid of the following IF tube is connected to a tap on the secondary winding. The output of the BFO is coupled to the grid of the second detector as well as to the grid of the delayed-AVC tube. As a result, considerable AVC voltage is developed when the BFO is on, reducing the sensitivity unless the AVC switch is turned off.

The headphone circuit differs from that of the HRO in that a separate sealed output transformer provides 10 mW of 600-ohm audio from the 6V6, the regular transformer being mounted with the loudspeaker.

The choice of a 175-kHz IF came from the need to receive Government, point-to-point, maritime and aircraft frequencies in the radio spectrum between 195 and 550 kHz. Neither the HRO Senior nor the Junior will tune through the 430-480 kHz range because of the 456-kHz IF. Furthermore, any second detector generates harmonics of the applied IF signal. With a power detector handling high signal voltages, harmonics (up to the third) can represent a large portion of the fundamental IF signal applied to the detector. The third harmonic of 175 kHz is 525 kHz, which, in the event of leakage from the second detector back to the first detector, could cause "birdies" (spurious responses). However, 525 kHz is safely above maritime frequencies (500 kHz in particular) and below the BC band of 540 kHz and above, so 175 kHz represents a good compromise. Image response at high frequencies suffers, of course.

The RAS power unit used a 5Z3 rectifier and a capacitor-input filter with 17-Hy reactor and paired 4-uF capacitors. The tube and fuses are accessible through the removable front grille.

During the war and afterward the RAS was used to monitor strike frequencies during naval operations, to listen to air-sea rescue channels, and as a control-tower monitor at locations not served by the Army Airways Communications System (AACS). Radio-repair facilities of individual land-based naval aircraft squadrons, Carrier Aircraft Service Units (CASUs), and Marine Air Groups (MAGs) usually managed to latch onto an RAS to listen to Armed Forces Radio, and, depending on location, to BC stations from the continental United States.



Rear view of the power unit. *[Photos: KB2EVN]*

A CIGAR-BOX RADIO

Bob Dennison, W2HBE
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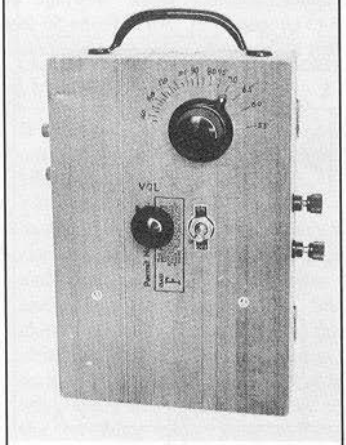
Between July 1932 and September 1935, Short Wave Craft featured a dozen intriguing portable radio sets assembled in various containers, such as cigar boxes, a bakelite shaving-kit case, a metal cash box, and homemade cases of wood or aluminum. These sets used one or two tubes, usually the '99 or the '30. Most employed plug-in coils wound on tube bases, a couple used tapped coils, and one saved space by placing one of the tubes inside the tuning coil. For B-supply, some used small 22-½ volt B-C batteries; others, multiple penlight cells connected in series.

In 1934, as a junior high school home-room project, I tried to build a cigar-box radio. My science teacher gave me plenty of encouragement but I lacked money and mechanical dexterity so the idea was abandoned in favor of a simpler breadboard set. A few years ago, I found a well made cigar box fashioned of straight-grained cedar with brass hinges and catch. I set it aside and resolved to start looking for vintage components for an old-time cigar-box radio. Most of the parts and tubes were found at the AWA Conference at Canandaigua.

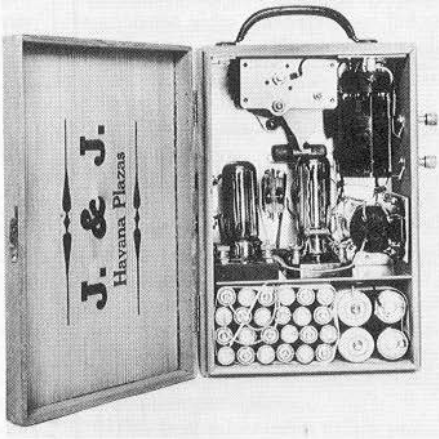
After reviewing the Short Wave Craft designs, I outlined the features to be incorporated, as follows: (1) Must tune all of the broadcast band; (2) Must employ two tubes to insure adequate headphone volume; (3) Current drain to be low for extended battery life; (4) Prefer AFT rather than RC coupling to secure extra gain; (5) Must use tubes and parts of the early Thirties.

Once the initial design was conceived, it was breadboarded and tested. Various problems occurred and were resolved. The final circuit is shown in the diagram. In order to reduce volume and regeneration to zero, it was necessary to connect R2 as a potentiometer rather than a series rheostat. This meant additional drain from the B-battery. However, the detector current is so low (less than 0.1 mA) that it is possible to use a very high value for R2 and still obtain essentially linear control of volume.

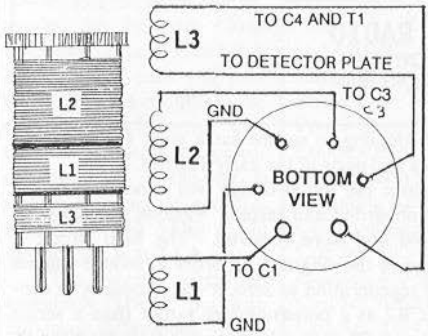
To tune all of the broadcast band requires the use of a 350- or 365-mmf tuning condenser (today they are called capacitors but before WW II they were known as condensers). The smallest one I could find was a Stewart-Warner G-80580. Erla made one of nearly the same size. After one chooses the other major components (coil, tubes, batteries) there is little room left for the audio transformer. The smallest unit I could find was a Hedgehog measuring 1-3/8" diameter by 2-1/8" long. The Hedgehog is so named because of its distinctive appearance, a result of its unusual construction. It employs toroidal windings which completely encase the core and hide it from view. The terminals project through the windings at one end. Because of its small size, the primary inductance is insufficient for high fidelity but is entirely



Front view. Headphone terminals are on the right.



Rear view. The Hedgehog audio transformer is just below the plug-in coil.



Coil-winding details. L1 - ant. coil, 50 t. No. 32 enameled, wound on insulating tape over bottom end of L2. L2 - secondary, 105 t. No. 28 en. L3 - tickler, 45 t. No. 34 en. Form - standard 1-1/4" dia., 6-prong type with 2-1/8" of winding space. The Bud form is ribbed.

adequate for headphone reception. Because of the low primary inductance and the high plate resistance of the '99 tube, this set does not exhibit fringe-howl, so no damping resistor is required across the secondary winding.

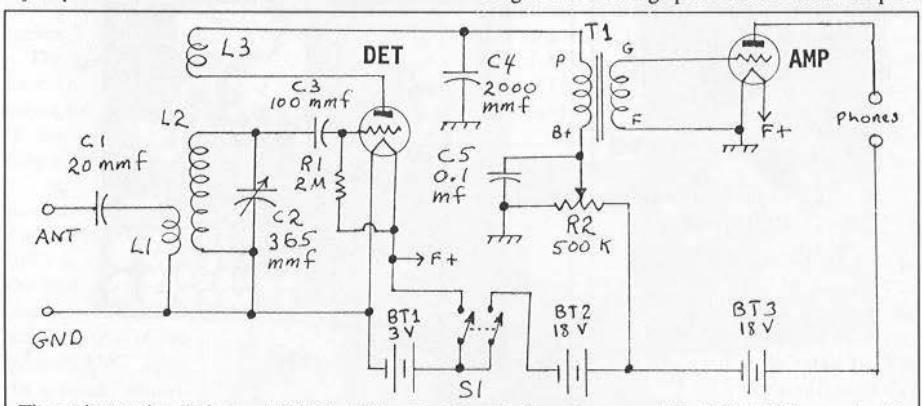
The plug-in tuning coil (L1-2-3) is a Bud No. CK-359 six-prong Junior Broadcast coil. The free-space inductance of L2 is slightly reduced when installed in the cigar box because of its proximity to the aluminum chassis. This was corrected by cementing two small fragments of a powdered-iron tuning slug inside the coil form (yes, they had powdered-iron cores in 1934!). The final tuning range was 540 to 1670 kc (we didn't say kHz in 1934).

The value of C4 was chosen so that the set goes into regeneration at 540 kc with the volume control nearly full on. Sets using other components may require a different value.

The outside dimensions of the cigar box are 6-3/16" X 9¼" x 2-5/8". Most components are mounted on a U-shaped aluminum chassis measuring 6-3/16" X 5-3/8" X 2-1/8". This provides shielding to eliminate annoying hand-capacity effects. The carrying handle is from an old screen door, attached by two 6-32 FH screws which pass through the cigar box and the upper flange of the chassis. The 4-40 RH screws pass through the back of the cigar box (the front panel) and thence through the lower end of the chassis to secure it firmly. The Hedgehog transformer is mounted on an aluminum bracket fastened to the chassis. The tuning condenser is attached to the chassis with three 6-32 FH screws. The switch and volume control are fastened to the chassis with their mounting nuts and bushings, and then project through holes in the cigar box. These holes are counterbored on the inside to clear the mounting nuts. After the chassis is installed in the cigar box, an ON-OFF escutcheon is added to the switch bushing to cover the hole. The other holes are covered by the volume and tuning knobs. This method of assembly allows most components to be attached to the chassis and wired before the chassis is installed in the box.

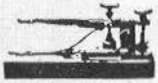
At the bottom of the box is the battery compartment measuring 5-7/16" X 2-¾". The B-battery is 24 AA penlight cells connected in series, with a tap at the center for the detector supply. Since the amplifier draws only 1 mA and the detector only 0.1 mA, long battery life can be expected. Four C-size cells in series-parallel give three volts for the filaments.

With a pair of Brandes 2000-ohm headphones, the volume on most local stations is such that the volume control is only half open. The author lives near Philadelphia so there is no shortage of strong signals to choose from. An antenna 50 feet long and 15 feet high proved more than adequate.



The schematic. Tubes - UV199. BT1 - four C-cells in series-parallel. BT2, BT3 - each, 12 AA cells in series. C2 - 356-mmf variable. C4 - see text. T1 - 1:3.5 ratio Hedgehog type.

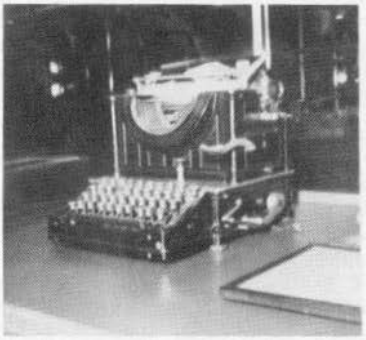
KEY and TELEGRAPH



EDITED BY
LOU MOREAU
W3WRE

Q: Keyboard keys are the latest type for radio telegraphy. Have there been any other kinds, or is this the only kind other than a teletypewriter?

A: No, the present keyboard instruments are simply a modern design that distantly echoes the 1902 Yetman Transmitter. You see, Charles Yetman was a wealthy man who was interested in finding a way of assisting the ease and speed of sending for telegraphers who were clearing thousands of words in a single shift . . . and that shift could be 12 hours a day, 6-1/2 days a week. Two years before Horace Martin's first semiautomatic, the Autoplex, Yetman introduced a typewriter-style transmitter to produce code characters on a telegraph wire instead of the alphabet.

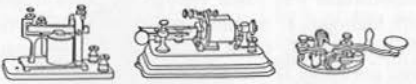


Yetman Transmitter. 1902 transmitting-only keyboard instrument. (Photo: William F. Moreau, 1955)

It apparently gave a typed copy of what had gone out over the wire at the same time, a major convenience for filing purposes.

It had two major drawbacks. First, an operator had to know how to type smoothly with a regular rhythm. If he/she were using an erratic "hunt-and-peck" style, the transmission would garble badly and the copy was useless. Second, the machine was only a transmitter and the receiving instrument still a Morse sounder. Thus, any trained typist could transmit but a professional telegrapher was required to read the sounder at the receiving end. Real telegraph operators would have nothing to do with the keyboard instrument. When the semiautomatics were introduced two years later, there was no need for the Yetman since the ease and speed had been accomplished. Then in the 1930s, the abbreviated form of a keyboard appeared in the McClintic key, the "Keen Kode Keyer."

There is an excellent example of the Yetman in the Henry Ford Museum in Dearborn, Michigan. I have no idea if there is any other in existance. Original examples probably did not survive since they cannot be used as typewriters. The illustration here is a snapshot taken some years ago.



VIBROPLEX COLLECTOR'S GUIDE

By Tom French, W1IMQ
88 pp., 45 illus., softbound, 8-1/2 x 11 format.
Artifax Books, Box 88, Maynard, MA 01754.
Available from Antique Electronic Supply, 602-820-5411, for $14.95.

This volume takes on three tasks: the history of the Vibroplex Company, which still exists after 86 years; the patents of Horace G. Martin, its main source of new designs; and the company's product line over the years. It does a creditable job of all three. The patent orientation is a unifying theme, since the company's competitive position was tied to protection of design innovations. Ten patents are reproduced in the book, with the considerable labor of recreating the text afresh rather than reproducing the usual smudgy copies from microfilm. The models are detailed, from Autoplex to Zephyr.

As for using the book to identify particular models: the descriptive text is straightforward, so it was no problem to pull a scruffy flea-market key out of the basement and identify it as an "Original." The book stops short of giving a simple chart of features, which would have condensed the identification part considerably. However, it offers numerous old-time Vibroplex ads and present-day photos to supplement the written descriptions.

This is an informative, crisply printed study of interest to both amateur CW enthusiasts and landline equipment collectors. [LAS]

THE MAILBAG

Readers' comments on early radio topics are welcome. Because of space limitations, letters that are published may have to be edited. Send all material to the Editor.

HOT-CHASSIS SETS

Your column on the "hot chassis" sets brought back a lot of memories from my days with the Raytheon Receiving Tube Division as an application engineer in the late Thirties. As such, I was closely associated with the set engineers and their problems. The issue that faced them was not really one of economics, but rather IF instability resulting from common coupling through the capacitor that returned the -B (i.e., one side of the power line) to the chassis. Although the 455-kHz impedance of that capacitor is only a few ohms and the IF current through it quite small, the combination was often enough to cause trouble with high-gain IF amplifiers. By the late Thirties improvements in tubes and IF transformers made even one-stage IFs troublesome.

The National NC-46 reviewed in the same OTB issue gets maximum gain and selectivity by using a two-stage IF rather than the more conventional and less critical RF amplifier and single-stage IF combination. Of course, they also saved a lot on coils and coil switching as well! With that very high-gain IF, everything had to be tied down to ground very tightly and whoever did the design had no choice. He could not afford a common coupling through a capacitor so you will note the -B is tied to the chassis, but by using a metal enclosure with a 0.1 μF between that cabinet and the external ground post, he avoided having one side of the power line where it would very obviously be dangerous!

As the result of controversy over what constituted acceptable leakage levels and how to measure them, the Underwriters Labs in the mid-Thirties came up with a standard which gave a measurement of leakage current and voltage on an external part. A receiver passing these tests was given the familiar UL label. I no longer have the circuit of that test jig, but I do remember it consisted of a couple of 6H6s and some assorted capacitors and resistors. The indicator was any old 1000-ohms-per-volt Simpson meter. The leakage current it allowed was one or two mA, and the voltage about 60. I am not sure how UL decided on these limits. But it is interesting to note that the current limit was set at a level where a 0.05 μF to the chassis would pass and a 0.1 μF would not! In some instances, a 0.1 μF was needed for stability. This kind of drove the engineers bananas! Believe it or not, I have seen sets where the designer used the biggest capacitor that would allow his set to pass and then placed an inductance in series with it which was wound on the capacitor itself. This effectively reduced the impedance via the $X = X_C - X_l$ route. That NC-46 would not pass the UL test but it sure was not going to kill anyone.

When I refer to instability I do not necessarily imply IF oscillation. Quite often it was difficult IF alignment - the kind where every time you turn the screws on the IF you get more gain and you go round and round. Also you can see that coupling between the cathodes is very probable because the mixer cathode always went directly to the -B and quite often the IF cathode did the same or was inadequately bypassed to the chassis.

Frank M. Dukat, K6NL

[There were some responsible hot-chassis designs where the chassis slid into guides molded in the cabinet, in which the mounting screws were inaccessible to the innocent user. But the receivers where you could light a 200-watt lamp on external mounting screws were inexcusable. Death is permanent. -Ed.]

FIXING AC-DC RADIOS

I enjoyed your article on repair of "All-American Five" sets. . . especially the fault analysis of the 64 receivers. Electronics is my hobby so my experience is less but I have had one case of a bad AVC cap with symptoms of low sensitivity and oscillations on shortwave. The AVC line was also RF ground for the tuning capacitor. The audio interstage coupling capacitor seems to go frequently and on an [Hallicrafters] S-20-R (sold to me by a ham who evidently couldn't fix it) both the tone control and the "quality" condensers were near-shorts across B+.

"Radio and Television News," May 1958, had an article about another kind of "leaky trimmer" repair in IF transformers, with a detailed test procedure for locating this trouble.

Will you review the Romney radio-repair book? [See Bruce Kelley's writeup in "Book Reviews" - Ed.] In my opinion, although it is entertaining and has many good bits of information, it doesn't give a clear procedure for checkout and repair of radios. Like Hallmark's book, it has good and bad points. Well, there's no one good book about car repair either, as an example of a hobby with a larger following.

I think the latest OTB is my favorite of the last six or eight.

Michael Harla

THE LOUDSPEAKER

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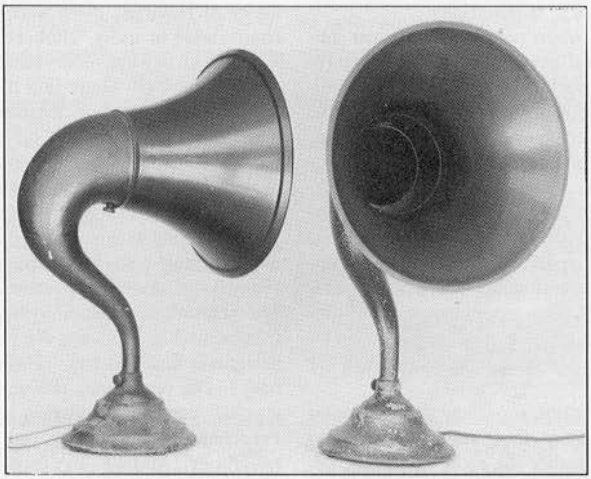
All correspondence requires SASE for reply

SAAL HORN SPEAKERS

The H. G. Saal Company of Chicago placed an ad in the 1924 Fall edition of the Citizens Radio Callbook showing two gooseneck horns of the same size. (Dimensions given were 21-1/2" high with a bell diameter of 13".) The horns were called "Grande." The "Symphony Grande" horn was priced at $35 and was available in gold stippling with a mahogany-colored bell. The "Concert Grande" loudspeaker was priced at $25 and was available in silver or black stippling with a black bell. The bells were about 1/4" thick, fairly heavy, made of solid bakelite. The driver used in these horns was an armature style. The necks and bases were of cast aluminum.



Radio Retailing for February 1925 announced a smaller 18" high horn, Model 24, with an 11" bakelite bell. Advertisements in several radio magazines in the Fall of 1925 called the larger-size horns a "Soft" speaker and offered them a little cheaper. The smaller horn was called Saal Jr., and sold for $20.

Saal, as a subcontractor, made horn speakers for another retailer. A 1924 Sears, Roebuck and Co. catalog advertised a "quality, $30" horn speaker for only $19.85. The catalog described a horn with a bakelite 13" diameter bell. The author has an 18" high horn with 11" bell and a pot-metal base. The above horns were made by Saal for Sears and had "WLS, Silvertone" tags on the horns.

While Saal made horns for another company, they also had someone else make a floor-pedestal wood horn for them. A close look at the Saal pedestal horn and the Hartman Electric version will show many similarities: the main difference between the two is the letter "S" instead of "H" integrated into the grill design. The floor pedestal horn was added to the product line by August of 1926.

The rather unique design of the Saal gooseneck speakers (bakelite bell) and the quality of the tone made the speakers a competitively sold unit. Some 75,000 horns were produced over a two and one-half year period. The horns are considered very collectable. By December of 1926 Saal was advertising the "Ec-centric" cone speaker and Saal horns were beginning a phase-out, although horn speaker ads ran into 1927 magazines.

(Continued from p. 14)

were rather delicate. Adjusting pots would burn and magamp settings would change in value. (Magnetic amplifiers or magamps sampled electrode current and set fail points to trip the high voltage breaker.) After studying the drawings and descriptions of magamp operation, I found that the diodes inside their cases frequently failed. Prying off their tops and replacing the diodes frequently cured the problem. The same held true for the regulating magamp in the 2.8-kV power supplies for the TWTs.

The elements of a TWT sometimes warped. Rotating the tube 90 degrees was a temporary solution. Sometimes the TWT shorted and destroyed power supply components.

As time went on, the quality of the TWTs and power-supply components improved and they became very dependable. Now they have largely been replaced by more reliable, low-noise solid-state units made by Avantek and other manufacturers - or the radio has been replaced entirely by optical fiber facilities.

TELECOMMUNICATION

EDITED BY
DON DeNEUF
WA1SPM

CURIE DISCOVERED MORE THAN RADIUM

Pierre Curie, who was born in Paris in 1859 and died there in 1906, is best known for his association with Madame Curie in the discovery of radium and polonium. It is seldom mentioned, however, that with his brother Paul-Jacques he discovered piezoelectricity, an important development in telecommunications. While studying pyroelectricity, he developed a theory which led him to foresee, before actually observing it, the new phenomenon of piezoelectricity.

He found that, when certain crystals are subjected to mechanical stress, an electric charge results. Conversely, such crystals produce mechanical force when voltage is applied in a suitable manner. Several natural crystal substances, including Rochelle salt and quartz, exhibit piezoelectric properties. The greatest effect is displayed by Rochelle salt (potassium sodium tartrate), which was used for many years in crystal microphones, phono pickups, and headphones until replaced by ceramics like barium titanate. Even ceramic capacitors are piezoelectric: connect a 0.1-uF capacitor to an oscilloscope, turn up the sensitivity, tap on the capacitor, and watch the trace bounce.

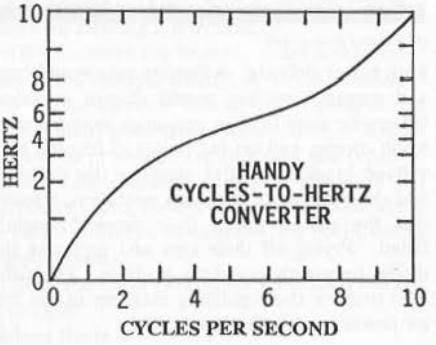
Control of oscillators, especially those in radio transmitters, to ensure their staying on a fixed frequency, was probably the most important development. In this application quartz crystals are used because of their permanence, low temperature coefficient, and high mechanical "Q." Crystal filters have also been built with other compounds like potassium diethylamine phosphate.

Another of Curie's important works was in the field of thermomagnetism. He found that there is a critical temperature, now called the Curie temperature, above which the magnetic properties of a substance disappear. For iron, this is 1043 degrees Kelvin.

CYCLES TO HERTZ

James Clerk Maxwell, a Scotsman, in 1873 mathematically developed the nature of an electromagnetic field, but it was Heinrich Hertz, a German, who actually demonstrated the wave character of electromagnetic transmission through space. He described his work to the Berlin Academy of Sciences on December 13, 1888, creating a sensation. His demonstrations were thereafter repeated throughout the world, paving the way for the development of wireless telegraphy. Guglielmo Marconi, so often referred to as the "inventor of wireless," denied this claim, saying that he had merely forged a practical telecommunications system from the discoveries of scientists like Hertz and Branly. (Edouard Branly, a Frenchman, invented the coherer detector in 1844.)

For many years, engineers referred to the frequency of alternating current in "cycles per second." When the term was changed to hertz, in honor of Heinrich, there were those who felt uncomfortable in using "kilohertz" and "megahertz" in place of the imprecise but familiar "kilocycle" and "megacycle." Some said the old name "cycle" was more appropriate because it described an electrical function. They had forgotten that most other electrical functions and terms were named in honor of a discoverer-scientist-inventor: Volta, Ampere, Bell (as in decibel), Erlang (unit of telephone traffic), Henry, Ohm, Watt, Napier (as in neper, a base-e cousin of the decibel), Coulomb, Faraday, Joule (watt-second), Galvani (galvanometer), Gauss (magnetism), Weber (magnetic flux, replacing the maxwell), and Tesla (magnetic flux density). Have I forgotten anybody? Oh, yes: baud, the unit of speed in telegraphic code transmission named after the Frenchman Emile Baudot, one of the pioneers of telegraphy. And we can't forget the movement in recent years to replace the unit of conductance, the mho, with the siemens, in honor of Werner Siemens. If tube testers were made today, they'd properly read transconductance in microsiemens; the conductivity of the earth around a radio tower is more formally stated as "2.7 millisiemens per meter" than "2.7 millimhos per meter."]



TRANSISTOR RECEIVERS

EDITED BY
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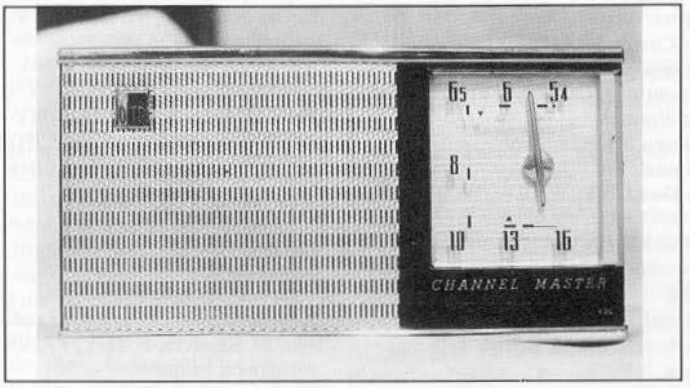
All correspondence requires SASE for reply

CHANNEL MASTER MODEL 6506

Rodney Schrock, KD3OR, Guest Columnist

About 1948, in the annual "April Fool" issue of Radio Craft, Mohammed Ulysses Fips, the "Office Boy," writes an article about the invention of the "Chrystron" - an imaginary solid-state device which detected and amplified, perhaps powered by a small external battery. Not much later, Bell Labs announced the invention of the transistor, fulfilling Hugo Gernsback's prophecy.

In late 1952, in the radio-receiver phase of Navy electronics school, one of my classmates asked the instructor: "What about this crystal thing that amplifies? Do you think it will replace the vacuum tube?" The instructor replied, "It's noisy and unreliable and its frequency range is limited. Unless something happens, it will be used only in children's record players and cheap portable radios." Some cheap transistor BC radios did eventually appear on the market, but they didn't seem to be too widely accepted. Perhaps my instructor was correct.

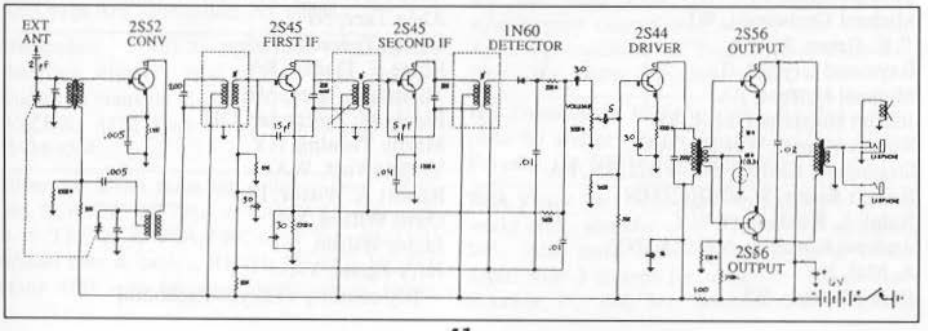


In 1960, after E2B transistorized single-frequency signaling units were installed in our AT&T office, I decided transistors were here to stay and bought a Channel Master 6506 for my wife. It was packaged in an attractive blue-and-white box containing the radio, a leather case, a headphone in its own case, and a wire antenna.

We used it for years as a kitchen radio, listening to KDKA early in the morning before the local BC station started its broadcast day. We took it everywhere, to the beach, picnics, etc., and it gave us many hours of troublefree reception. Later, we replaced it with an AM-FM model powered by AC. Now it is used during power outages and to locate RFI.

If we examine the schematic, we find it is typical of the era. Battery-operated, autodyne oscillator-converter, two IFs, a simple AVC to the emitter of the first IF and base of the second IF stage, and a transformer-coupled push-pull output. Its operation has been almost troublefree except that several electrolytics went sour: I had to replace the four 30-μF bypass capacitors to end oscillation and restore proper gain.

A lot of these sets were sold and I'm sure some of them are in use today.



NEW MEMBERS

AWA welcomes the following new members. We list all new members routinely - if your name does not appear within six months, please advise the Editor. If you do not wish to be shown, just mark the application form accordingly. AWA does not provide an address list or other directory of its membership.

Bruce **Adams**, W1UPB, RI
Jon Brent **Allen** & Carolyn **Etzel**, TX
Allan V. **Anderson**, NY
Leland L. **Bahr**, TX
Gordon K. **Bean**, K8MRS, MI
Maxwell Berman, CA
Walter L. **Brink**, W3WPY, MD
Armand R. **Brunette**, WB1FMV, NY, U. S. Coast Guard
Linda A. **Campo**, NJ
Michael J. **Carey**, IL
Bill **Carns**, W7OTQ, AZ, Motorola
Robert **Colton**, CA
Richard C. **Crispi**, CT
James P. **Cross**, OH
G. Graydon **Curtis**, K2AHH, NJ
Mark C. **DeFrancisco**, NJ
Roman **Dementiuk**, N2CDD, NY, former submarine radioman
Robert M. **Dern**, KF8GK, WV
Louis A. **Dimasi**, PA
Kenneth A. **Dodd**, NY, WKBW, WOR, WWOL, WGVA
Francis E. **Donadio**, NY
Henry L. **Duncan**, K4MNY, GA, CAA/FAA electronics
Willian E. **Dunham**, NY
Reginald **Dykes**, England, British Telecom
Wayne **Eaton**, NY
Dave **Fazzini**, IL
Thomas T. **Flythe, Sr.**, NJ
Joseph R. **Forth**, WA2TRT, WV, East Coast Electronics
C. K. **Friend**, NY
Tom **Garcia**, N7CHG, AZ, DJ, TV news 1950s
Al Goldstein, NY, TV broadcaster
Richard **Goodwin**, IL, radio announcer, operator, etc.
Tom **Gorman**, VA
Michael **Grabowski**, WI
T. E. **Green, Jr.**, PA
Raymond **Grygiel**, IL
Michael **Heffner**, PA
Joseph **Holstein**, N8EA, MI
Robert **Hough**, W8ESR, WV
Stephen A. **Kalista**, Sr., WB2LKN, PA
Robert **Kemp**, WA0VRC, MN
Ralph L. **Kilsheimer**, NY
Andrew **Kinsman**, N2HZK, NY
A. **Mal**, NY
Dale **Kinstler**, WI
Kenneth L. **Koski**, NY
Lars **Larsen**, CA
Thomas W. **Lee**, NY, Motorola
Joseph M. **Lima**, CA
R. E. **MacPherson**, FL, electronic/loudspeaker repair
Walter J. **Maier**, NY
Linda **Marsh**, WI
Philip G. **McCoy**, MD
David **Mednick**, NJ
Stephen **Melkisethian**, MD
James W. **Moore**, VA
Jerry **Moore**, MO
Ralph T. **Naslund**, MO
Harold G. **Newell**, WA3MVW, PA, radio-TV sales-service, 38 yrs.
Charles D. **Newman**, NY
David **Pacitto**, NY
Walter J. **Paluch**, KA2CAQ, NY
John L. **Pike**, WA2UKS, NY, IBM
Ludwig **Prechtl**, OE1LPS, Austria
Earl M. **Raeburn**, CA
Joseph A. **Ricci**, PA
Bobby **Ridge**, NC
Wes **Ridgway**, MO
Albert A. **Roehm**, W2OBJ, NJ
Gary **Rotterman**, NY, USAF radioman
Irvin M. **Sanders**, K3IUY, PA, electronics business owner
Henry M. **Scher**, PA
John C. **Shideler**, WA0NEV, CO, KFBC, KFBQ
David B. **Skidmore**, WB8CBO, OH
Robert D. **Smith**, CA
David D. **Speck**, MD, NY
Herschel **Stansch**, AA6QY, CA, commercial CW operator, engineer
Mel **Stoller**, K2AOQ, NY, WBBF-AM, WROC-AM-FM-TV
Mike **Strother**, NY, WGSU, Geneseo Campus
Alvin **Tarr**, NJ
Enrico **Tedeschi**, Italy
Bruce E. **Tjaden**, KY
Thomas F. **Trice**, ME
Hardy W. **Trolander**, OH
Martin **Twining**, NY
Vernon **Vogt**, WA
Robert A. **Wietor**, FL
Davis **Wilson**, MD
James **Wilson**, NY
Jerry **Zgonc**, VA

[By courtesy of Joyce Peckham]

HISTORICAL ARTIFACTS

Old-time ads are free to members collecting and restoring equipment for personal use. **The rules:** (1) only one per issue per member; (2) include an SASE if acknowledgement is desired; (3) material must be over 25 years old and related to electronic communication; (4) give your full name, address, and zip code; (5) repeats require another notice - we aren't set up to repeat automatically; (6) the Association is not responsible for **any** transaction; (7) we retain the right to reduce the size of the ad if over seven lines; (8) AWA does not accept commercial advertising; (9) deadline for ads in next issue: December 7; those received later will be held for the following issue. Mail **all** ads to:

Richard Ransley, 17 Sheridan St., Auburn, NY 13021.

FOR SALE/TRADE

Old-time magazines and books, excess from AWA Museum. See announcement on page 6.

1948 **Heathkit oscilloscope**, Model 3. Exc. electronics, VG cabinet. $40 with manual & schematic. Want clock crystal for Zenith clock radio X179G. Jasper De Lasse, 17 Seldin Ave. Staten Island, NY 10314, (718) 761-6559 or 981-1218.

1950s **Polic-Alarm** PR8 brown bakelite, $22; Zenith 1930s 705 wood, $75; Sparton mid-1930s tombstone, $110; Coronado 1940 1070A large tombstone, pushbuttons, $80; Philco Phone intercom 9011, late 1930s, wood cabinet, exc., untested, $20. SASE for more. Ripley, Box 9374, North St., St. Paul MN 55109, (612) 777-6791.

69 years' **collection** of xmtr-receiver parts, man-military literature, flyers, books, old TVs, phonos, test equipment, ham, military, parts, 20 Radio Master catalogs, catalogs (Cameradio, McGee, Olson, Burstein-Applebee), more. SASE and $1 for 48-page. F. Yonker, W2IBH, 7 Old Farms Road, Saddle River, NJ 07458.

Old parts, radios, literature, odds & ends. Lsase for list. Berj Ensanian, KI3U, Box 3342, Williamsport, PA 17701, (717) 326-2148.

Radio parts, tubes, service manuals for sets made 1920-65. No list; write wants w/SASE. Krantz, 100 Osage Ave., Somerdale, NJ 08083.

Schematics: 1920-70 radio-ham-TV-Canadian electronic organ - misc. $3.50 plus postage. Quotes on manuals. Send SASE. Alton Bowman, W2ZUX, 4172 East Ave., Canandaigua, NY 11424-9564.

Silvertone 2-volt farm set; military gear: SCR-284, SCR-522, BC-728A & rack, ARC-1 & rack, R-19/TRC-1, R-276A/FRC-6, R-394, PE-110D w/field case & cables, RM-21; PE-73C; NC-173. Many TMs - no list, send wants. Wm. Bauer, W4NZY, 119 North Birchwood Ave., Louisville, KY 40206, (502) 895-3275.

Trade my nice **Clapp-Eastham C-23 Radak** (see Douglas, p. 105) for National SW-4 in good cond. Robert Enemark, W1EC, Box 1607, Duxbury, MA 02331, (617) 934-5043.

TV sets: RCA 630TS $250, 8TS30 $200, RCA projection $150; DuMont 20" Westminster $200; CBS 19" color, Hoffman 19" color (1954) $450 each. Harry Poster, Box 1883, South Hackensack, NJ 07606, (201) 794-9606.

Victor/Edison needles and reproducing heads and cartridges from 1940 to 1980. Magnetic and ceramic cartridges. J. J. Papovich, 53 Magnolia Ave., Pitman, NJ 08071, (609) 582-8279.

Philco 513 with AK speaker, complete with tubes, AC powered. Case is tin "breadbox" with flowers painted on front and lid, ca. 1933, asking $125. A. A. DuBois, Jr., RD 6, Box 180E, Queensbury, NY 12804.

Complete 74-year **QST collection** from Issue One. Minimum offer $3000. Ken Miller, K6IR, 16904 George Washington, Rockville, MD 20853-1128, (301) 774-7709.

Aircraft beacon rcvr., ca 1939, RCA AVR-15 (200-400 kHz) w/antenna xfmr, orig. install. w/service manuals. RCA 630TS circuit, personally assembled from Techmaster kit (1947), w/mahogany cabinet and service data manual. All in VG condition. L. Bogdan, 9348 Lake Rd., Corfu, NY 14036, (716) 599-3194.

IRE Proceedings, 1928 thru 1938. SASE for complete list and prices. N. W. York, 17356 Miller, Fontana, CA 92336, (714) 822-5993.

RCA Victor T6-1 tombstone w/shortwave bands, works well, scratchy controls, VG to excellent, $95. Also many other radios, books & tubes. SASE with 2 stamps for complete listing. Ron Boucher, PO Box 541, Goffstown, NH 03045,

(603) 497-2988.

100+ B&W TV sets, 1950-70, 50+ NIB CRTs including 400N322 (first rectangular color). Will donate all to technical or high school wanting same. 100+ car radios 1934-74, $100 takes all. Tested NIB 6-volt vibrators, ATR 334 (replaces Philco 38-5036) $50 per 24 pcs. shipped. Jim & Nadiene Farago, PO Box 6313, Mpls, MN 65406.

Addison, burgundy and orange small Catalin radio for trade only. Will trade for Charlie McCarthy or Pepsi bottle or collor radio, Coca-Cola bottle or cooler radio or Dr. Pepper cooler radio. Mike Huen, 52 St. Annes Rd., Winnipeg, Manitoba R2M 2Y3, Canada, (204) 255-3463.

250 books, radio related, list #6, SASE. Photocopy of 1847 booklet describing Morse's first telegraph in great detail, authored by assistant A. Vail, 14 engravings, 26 pages, $8.50 postpaid. Photocopy of 1923 Radio Experimenters' Guide by Neward Sunday Call including circuits of 10 one- to three- tube radios, listing of BC stations and more. 50 pages $8.50 postpaid. T. Wickstrom, 1664 E. Shore Dr., St. Paul, MN 55106.

Tubes, 51 JAN-2E26 in boxes, $50 for lot. Appear to be new. Two JAN-4X150A new in foil-sealed packages, $25 each. Murray Shapiro, 2931 Northwood Dr., Endwell, NY 13760, (607) 748-0233.

Collins new tube sets: KWM-2, $95 less finals, 75S-3 $65, 32S-3 $60 less finals, 75A-4 $85. Bob, 65 Aleta Dr., Rochester, NY 14523, (716) 334-1103.

Silvertone 1406 cathedral, refinished, working, exc. cond., $125. GE H-634 multiband, exc. cond. and wkg. $70. Amrad Cabinette, mint, wkg., $150. Philco Model 20 cathedral, prof. refinished, wkg. $350. Want Radio World and Science & Invention magazines. Andrew Mooradian, 5 Priscilla Ln., Winchester, MA 01890.

Vintage audio equip., novelty radios, and misc. radios. SASE for list. Want portable radio that uses peanut tubes. Mark Land, 288 Dartmouth, Rochester, NY 14607, (716) 473-6838.

Philco 65, AK 40 w/custom cabinet, Radiola 44, Blackhawk tabletop, Philtane coin-op, Revere 400 camera radio, Sonochorde and Meister Singer spkrs, assorted Riders manuals and pubs, more. SASE for list. Want shell for Philco 90B. Mike and Karen McCoy, 8301 Brookridge Dr., Oklahoma City, OK 73132, (405) 722-0595.

Old radio parts for sale. SASE for photograph. V. Vogt, 330 SW 43rd St #247, Renton, WA 98055.

McMurdo Silver 700 xmtr $40. National NC-303 ham-band receiver $65. Millen grid-dip meter with all coils plus 3 low-freq. coils covering 325 kHz to 20 kHz $45. SASE for equipment and technical books. Roland Martick, RR 1, Box 1668, New London, NH 03257.

Craftsman C800A chrome-plated FM-AM tuner, 500-A Ultra Fidelity Amp, pair KT66 output, Garrard RC-80M turntable, all in blond mahogany cabinet. Electro-Voice, 12TRXB Triaxial speaker in matching E-V Aristocrat folded-horn corner enclosure $450, includes diagrams & spkrs. A. Delucia, 136 Keyel Dr., Rochester, NY 14625, (716) 381-7375.

WANTED

Any type of **RCA AR88 receiver** family; AR88, AR88D, CR88, CR88B, etc.; complete or parts. Pick up within 200 miles. R. Haworth, 112 Tilford Road, Somerdale, NJ 08083.

Clean **E. F. Johnson Navigator**; Speed-X bug. Allen Chapman's Radio Boys to the Rescue. Brian Roberts, 3068 N. Evergreen, Pittsburgh, PA 15237.

Coil-winding machine, Rider's Vol. 23, Rider's Automatic Record Changers and Recorders, and Most Often Needed Radio Diagrams by Supreme Publications. Schematic for National NC-155. Dan Healy, PO Box 764, Woodacre, CA 94973, (415) 488-4596.

Crystal sets wanted. Collection is now at 178 pieces and I am seeking more. Please make offer (if possible with photo). Erwin Macho, Ambrosweg 17/A/8, A-1230 Vienna, Austria.

Dubilier "Duratron" RF xfmr, 225-550 meters; W. E. 205D or 205E, 231A or 264A tubes; Crosley 52 audio xfmr (open windings OK); stylus for Edison diamond-disc reproducer. Have for sale/trade lid for RCA 60 in VG cond.; like-new battery cable for Radiola 28; two RCA 1949 ion-gauge tubes to measure degree of vacuum in vac. systems. Tad Drogoski, 507 Coal Valley Rd., Clairton, PA 15025.

DV3A tube(s) with filament intact; also DV3 tube cans and packing. Charles Swigart, 3717 Burton Ave., Toledo, OH 43612.

Early quack medical devices, scientific instruments, small open-frame motors and dynamos. Richard Cane, 8391 N.W. 21st St., Sunrise, FL 33322, (305) 741-6838.

Military radios, any vintage, any related items. Trades. 801 and 803 tubes. Charles Di Cecca, 501 Mystic Valley Pkwy, Medford, MA 02155, (617) 396-9354.

Radar equipment, APS-2, -4, -6, -10, -15, -20, and other airborne sets. Ground sets TPS-1, -10, SCR-584, -784, -615, etc. Units or complete or

info leading to same. Allan Weiner, 14 Prospect Drive, Yonkers, NY 10705, (914) 423-6638.

Schematic and tuning info for National RCK. Gordon Wilson, 11108 50th Ave., Edmonton, Al., Canada T6H OH9.

Spherical audions, Audiotrons, tubes from de Forest, Weagant, Schickerling, and other unusual tubes in any size or cond. Will pay fair price or exchange. Udo Radtke, DJ5KG, Im Fuchtei 143, D-4830 Gutersloh, West Germany, 011/49/5241/-51921.

Telegraph bugs (speed keys) for the largest collection in existence. Need types by Apex, Boulter, Leach Relay, Brown Bros., or or the early patent models made before 1930. Have trades. Gil Schlehman, 335 Indianapolis Ave., Downers Grove, IL 60515, (708) 968-2320.

Western Electric 3A and 4D rcvrs, working or parts; 2A power supply; 2A & 2B tuning units, 205D and 217A tubes. Marc Ingenthron, 9748 Outlook, Overland Park, KS 66207, (913) 642-4767.

World's Record (1925-27), Scott Transformer Co. (1928-30), E. H. Scott (1931-41), Crosley WLW and Zenith Stratosphere radios. Jim Clark, 1292 Starboard, Okemos, MI 48864, (517) 249-2249.

Radio books, magazines and catalogs prior to 1925. Also any Marconi Wireless receiving and transmitting gear prior to 1920. James Kreuzer, Box 398, Elma, NY 14059, (716) 681-3186.

Information on Air Associates Inc. aircraft radio system Type BR3T. Clean and unmodified NC-240D w/spkr. Vance Gildersleeve, K5CF, 206 Michelle Dr., Poteau, OK 74953.

National "Thrill Box" SW-4 and accessories, or SW-3, SW-5. Collins 75A1 rcvr and 32V1 xmtr for spare parts. Need suggestions and memorabilia for 1947 ham station featuring my 32V1 and 75A1. Also looking for an Ellis microphone (ad in 1927 QST). Carty Ellis, KA2Y, 32 Upland Dr., Rochester, NY 14617, (716) 544-3249.

"Little General" table model radio made by General Motors around 1930. Also want to buy or borrow the following books: The History of Automotive Radio by Dan Klear and Mike Coady and The Auto Radio - A Romantic Geneology by Don Matteson. Cress Donbar, K4YL, 4908 4th Ave. Circle NW, Bradenton, FL, (813) 746-7055.

Utah Jr. xmtr manual and/or schematic, ca. 1938. Will pay rasonable photocopy costs or trade for WE tubes. Bob Mattson, KC2LK, 10 Janewood, Highland, NY 12528, (914) 691-6247.

Manual or circuit of Navy transceiver Model CAY-43007 made by Westinghouse in 1941. Write to J. Cadrecha, 292 S. Prospect St., Burlington, VT 05401.

RCA 103 speaker, the one in the octagonal frame with floral tapestry grille, in good physical and op. cond. Arthur Peterson, 9006 W. Shorewood Dr., Apt. 507, Mercer Island, WA 98040.

Hammarlund 12-in. speaker cabinet for early SP-110 series Super Pro receiver. Henry Fautsch, K2ANL, 895 Inman Rd., Schenectady, NY 12309, (518) 346-1924.

Doolittle, Claravox, Pennsylvania Wireless, Ainsworth, Bosworth, Adler-Royal, Bird Radio Corp., Thomas Corcoran Lamp Co., Cleartone, Fairview Electric Shop, Roll-O-Radio radio sets and/or reproducers. George Freeman, 102 E. Main St., Madison, IN 47250, (812) 265-6878.

Any type general-coverage ham receiver, working or not. Joseph R. Forth, 321 Long Vue Acres, Wheeling, WV 26003, (304) 277-3154.

Any pre-1965 **Zenith Transoceanic**, mint or near-mint and good op. cond. only. Michael Fucci, 3444 4th St., Oceanside, NY 11572, (516) 763-2767.

Federal 59 cabinet; RCA SW conv. parts set (1929, uses plug-in coils); AK-19 cabinet. Allen Jochem, 2205 Broadway, Quincy, IL 62301, (217) 223-6751.

Lysco 600, B&W 5100B, 32V3, RMCA ET-8019, AR88, CR88, Mackay 117B VT QRP rigs, all RME VT RX, LF coils for HRO-5, within 150 miles of my QTH. Al James, K8CFC, 1240 Galazy, Cleveland, OH 44109, (216) 741-8999.

Old telephones, parts, and any memorabilia dealing with telephone communication before 1960. Interested in old color sets. David Fazzini, 18716 Baker Ave., Country Club Hills, IL 60478.

Internal horn speaker in good condition, or parts set, for RCA Radiola 24. Also any unusual horn speakers. Send your list. J. R. McDermain, 8302 Stonewood dr., Sandy, UT 84093, (801) 943-6005.

Millen 90800 50-watt xmtr and coils. Robert Kurth, W5IRP, 403 Montooth, Lufkin, TX 75901.

Old telegraph keys, sounders, relays and Vibroplex bugs. F. W. Nicholas, W7RBF, PO Box 37094, Phoenix, AZ 85069, (602) 864-9987.

Old violet-ray unit, ozone generator, diathermy machine, and electrical, radio and physics books. Hank Andreoni, 250-D S. Lyon Ave., Hemet, CA 92343.

World Radio Handbooks, 1940s to mid-70s. Also verification (QSL) cards or letters from domestic and foreign broadcasters, AM or SW preferred. John Herkimer, 3233 East Ave., Caledonia, NY 13323.

Early **British crystal** & battery sets, Amplion

AR19 horn, AK double crystal detector or AK crystal set, E. H. Scott Phantom Deluxe (20 tube) in a Braemar cabinet. Early Scott Transformer Co. battery sets. Mike Ceklovsky, 3116 Smoky Ct., Sacramento, CA 95826.

Hallicrafters S-38 in top working condition. Walter Maier, 6 San Mateo Rd., Rochester, NY 14624, (716) 247-5197.

Navy ARB xmtr tuning coils, mount, control box and dynamotor. If it says ATB (or ATD) on it, please let me know. Henry Engstrom, PO Box 5846, Santa Rosa, CA 95402.

3/8" paper-tape rolls to fit BO-1016 ink-pen telegraph recording unit; two type 809s; Hallicrafters S-35 Pan type 3RP7 CRT. Nicholas Oland, 821 Kenhorst Blvd., Reading, PA 19611.

Giblin-Remler honeycombs with the following windings: 25, 35, 50, 100, 150, 200, 250, 300, 400, 500, 600, 750, 1000, 1250, 1500 mH. Will buy or trade for de Forest and Branston honeycombs. Triad tubes and/or boxes of following: T-27 (227), T-26 (226), T-71, T-21A, T-80, T-22-RF. Leonard Arzoomanian, 61 Columbus Ave., North Providence, RI 02911, (401) 232-0869.

Loan or photocopy **AWA Review 1-43** having the Philco Farnsworth history. Will trade an RCA tube book (1968, 650 pp.) for above loan or copy. Tom Garcia, Box 15186, Tucson, AZ 85708.

Operating **instructions** (not tube data) for **I-177B** tube tester. Photocopy fine. Books on repairing 1940-80s communication receivers. McCreery, 205 Northern Ave., Decatur, GA 30030.

World's Record (1925-27), Scott Transformer Co. (1928-30), E. H. Scott (1931-41), Crosley WLW and Zenith Stratosphere radios. Jim Clark, 1292 Starboard, Okemos, MI 48864, (517) 349-2249.

AK 5 with tags, AK 50, AK cathedrals. Grebe CR-18, Aeriola Jr., and Grand. Also Radiola V, VI, VII, VIIB and IX. Will buy quality collection, small or large. Ed Bell, 5311 Woodsdale Rd., Raleight, NC 27606, (919) 851-1517.

Rider's books: Automatic Frequency Control Systems, Servicing Superhets, The Oscillator at Work, Resonance and Alignment. Harry Stavert, 7231 68th Ave. NE, Marysville, WA 98270.

WE tubes, seeking a 201A/CW-186 (dud ok); book by W. P. Banning: The WEAF Experiment. Have for trade a new copy of Electronics Technology, Vol. 6 of Bell Labs History series. Attila Balaton, 56 Oakland Pl., Summit, NJ 07901, (201) 522-9466.

Any schematic or **information** on a **German military radio** Model K32GWB made by Siemens. Also need any of the following German tubes: DCH11, DAF11, DF11, DL11, and UY11. Charles Pierce, WD4KQD, 4380 E. Brookhaven Dr., Atlanta, GA 30319, (404) 233-1340.

AGS or AGX, Howards, Bretings or Sargents. Pay cash or trade; SW3/SW5 coils and National power supply, Ramera (camera and transistor radio), RAS-5 (WW II HRO Jr.) with 6 coils, never-built Artone 2 radio kit, CE20A SSB xmtr. Need speaker bezel for Hallicrafters 5T. Joel Levine, 67 Derby Ave., Greenlawn, NY 11740.

Original **back issues of OTB** in excellent condition: Vol. 1 (No. 1) thru 13; also Vol. 14 (1, 2, 3); 15 (4); 16 (1, 2, 3) 17 (3, 4); 18 (1, 2); 21 (2, 3, 4). Bill Ross, KY9M, 1124 Tower Rd., Winnetka, IL 60093, (800) 621-0687.

Set of 5 shortwave **coils for Pilot Wasp**, 5-prong with handles. (My set was stolen from the A-C-D Museum.) Trade or cash. Ross Smith, 1133 Strong Ave., Elkhart, IN 46514.

Zenith console chassis, multiwave, anything built 1932- 39 will do. Will consider buying a complete console. Howard Sheeran, 3 Mulqueeney St., Wodonga 3690 Victoria, Australia.

U. S. **Army technical manuals** TM-11-809-20, Organizational Maintenance Manual, and TM-809-35, Depot Maintenance manual, for radio transmitter T-368. Book, Radio Antenna Engineering by E. A. Laport. Bill Mills, KC5PF, 1740 Tonya Ct., Amissville, VA 22002, office (703) 818-3955, home (703) 937-4090.

Want to locate anyone with **knowledge** of the development of GE's design of their new line of sets in late 1935 to 1937 for an article in the OTB. Ray Larson, 12241-1/2 Gorham Ave., W. Los Angeles, CA 90049.

RCA communications receiver CR-88B in any cond. Original cabinet from RCA AR-88/CR-88. Sam Thompson, W6HDU, 1031 San Antonio Ave., Alameda, CA 94501, (415) 521-1429.

Two **headset/mic assemblies** for Canadian 58 set TX/RX needed to complete restoration. Morse key and ant. assembly for TBY-8 VHF TX/RX. Two- or three-set mtg. rack for Command RX. TX assembly from TPS-3 radar or VT-158 tube. Radar jammers APT-2, APQ-9, APT-4 or TDY-1. Can arrange payment in US dollars and shipment from New Jersey. Rod Burman, G4RSN, "Kinnagh," Hancocks Mount, Sunningdale, Berkshire SL5 9PQ England.

Johnson Avenger - Johnson's attempt at a solid-state SSB transceiver in the early '60s. Had dual VFOs. Bob Kemp, 1104 W. Lyon, Lake City, MN 55041, (612) 345-5345.

Motorola 5A5 (FOS p. 113), 51M1U, 51M2U, 52M1U, 52M2U "Playmate" and "Playmate Jr."; RCA 54B1 mini portable; Emerson table model like #336 but with horiz. louvered grille, handle in bakelite; Zenith Royal 3000 Transoceanic; top-quality reel-reel recorder such as Ampex 960 or Sony 777-2 in working cond. 67-1/2 V batt. eliminators such as Maxell, Radio Shack, Lafayette. White's Radio Log, 1936-56. Allan Sherry, 5410 Netherland Ave., Riverdale, NY 10471.

Info on **Collins AN/ARC-2** autotune xcvr: loan of diagram or manual to copy, history, what aircraft it was used in. Needed to complete OTB article. C'mon, guys: at least one of you used to fix avionics in the Navy. Ludwell Sibley, 44 E. Main St., Flemington, NJ 08822, (908) 782-4894.

BOOK AND MAGAZINE REVIEWS

Edited by Bruce Kelley

FIXING UP NICE OLD RADIOS

By Ed Romney, N4DFX (186 pp., 8-½" X 11" looseleaf format, $19 + $1.50 shipping from Romney Publishing, Box 96, Emlenton, PA 16373).

Here's a handy book for the collector: in straightforward terms it illustrates the equipment and procedures to repair tube broadcast and amateur receivers. It covers general information on receiver design, circuit-identification charts and codes, and basic schematics. This is followed by case histories on several popular sets, including AK, Grebe, and Scott. Shortwave receivers include the Pilot Super-Wasp, SW-3, Hallicrafters, and HRO. The author is a former broadcast engineer and radio instructor. [BK]

TITANIC: R.I.P.

By D. E. Bristow (214 pp., paperback, illustrated, $7.95 plus $.48 postage from the author, Box 110462, Hialeah, FL 33011-0462.)

Members interested in the part that wireless played in the Titanic disaster will find this book of value. The author has done much research and devotes several chapters to actual transmissions from various vessels that were in the North Atlantic on April 13-15, 1912. Much of the text is from testimony at the official inquiry as well as statements by crew members of nearby vessels.

It is an easy-reading book with 27 short chapters and includes the author's views on the "Mystery Chip" and the bunker fire. I sense that Bristow feels Ismay may have indirectly encouraged Captain Smith to make a speed record. Maybe not. Good reading. [BK]

CLASSIC PLASTIC RADIOS OF THE 1930s AND 1940s

A Collector's Guide to Catalin Models

By John Sideli (127 pp., 8-½ x 11" format. $19.95 paperback, $29.95 hardcover, from Vestal Press, 607-797-4872.)

In this book John Sideli, a promoter closely identified with the Catalin craze, presents a somewhat egocentric view of how a once-obscure class of AC-DC receivers became prime collectibles. He traces the impressive run-up in prices through a Manhattan exhibition and the subsequent national hunt for these sets.

The story is shaped heavily by the nature of the New York City collector market, which contains an awful lot of money chasing a few scarce goods. (The text advises readers who fail to reside on the East or West Coast that they dwell in the "Great-In-Between.")

The book is an excellent job as a reference source or as just plain reading. Its professional layout covers 21 manufacturers' products, with 227 (!) crisp photographs that show off the glowing colors of the plastic and the styling of the cases: the simpler ones quite pleasing; others looking dated and bizarre. The text gives the differences between humble Bakelite and elegant Catalin, covering the production aspects of dry-molded cabinets versus cast-resin ones. It is not as detailed as Ed Lyon's very thorough "Catalin Corner" series published by the Mid-Atlantic Antique Radio Club, but fully informative.

Classic Plastic Radios bids to become a standard reference on these sets. However, with its focus on external design, it fails to mention the safety aspect of some of these sets: the hot-chassis models can deliver quite a bite. [LAS]

"A DREAMER WHO MADE US FALL IN LOVE WITH THE FUTURE"

By Daniel Stashower (Smithsonian, August 1990, pp. 44-55.)

This is a charming biographical study of Hugo Gernsback by a younger cousin. It describes Gernsback's role as an electronics publisher and, more importantly, a pioneer in the field of science fiction. It is lavishly illustrated with color covers from Gernsback's umpteen magazines, including Electrical Experimenter, Radio News, and Television News. Excellent reading. [LAS]

1990 PRICE GUIDE: VINTAGE TVs, 1935-1960s PLUS CATALIN, NOVELTY, AND MIRROR RADIOS, 1935-1950s

By Harry Poster and John Sakas (28 pp, 5-½" x 8-½" format, 7 illus., $10 from "Sight-Sound-Style," Box 2224, South Hackensack, NJ 07606.)

Printed price guides usually offer radio collectors general coverage with limited information. The 1990 Price Guide provides something different: it gives a wealth of data on a wide range of specific models, making it a valuable guide for one collecting early TV and novelty radios.

As with all collectibles, the worth varies with condition and sales circumstances. With this in mind, the values in this neat little guide are recommended only as a reference. I found the figures on television sets realistic but reserve comment on Catalin sets selling in the $2000 to $10,000 range, having never seen an extensive sales or auction listing with these high numbers. [BK]

THE MUSEUM

AWA ELECTRONIC COMMUNICATION MUSEUM

Location: Village Green, Rtes. 5 & 20, East Bloomfield, New York
Hours: May 1 through October 31: Sunday, 2-5 PM; June 1 - August 31: Saturday, 2-4 PM; Wednesday, 7-9 PM. (Closed Holidays)
Group tours by appointment: 716-657-7489
Museum telephone: 716-657-6260
Amateur Station: W2AN
FREE ADMISSION

NEW MATERIAL IN AWA MUSEUM

(sets, parts, books, magazines):

Paul Andrews; Dave Atkins, W6VX; Jerry Berg; Mike Csontos; Alan Dorhoffer, K2EEK; Malcolm Greenhill; Elmer Wagner, WB2BNJ; Jim Van Graafelland; Doug Hogg; Fred Norvik, W2GH; Ray Robbins; Bill Shaw, W2HYN.

MOVIEMAKERS AT MUSEUM

The Museum was the scene recently for a crew of moviemakers. Their project: conducting interviews and photographing artifacts for a production to be released this winter over PBS. The subject is three historical figures: Maj. Edwin Armstrong, Dr. Lee de Forest, and Gen. David Sarnoff. Several AWA members are involved in the project, both in production and the film. Details later.

ARRL-QST AT MUSEUM

The Museum was also visited by two ARRL Headquarters representatives: Jim Cain, K1TN; and Jim Kearman, KR1A; who photographed and recorded historial material. The museum's displays of the rich heritage of amateur-radio development appear to be worthy of a feature article. The illustrated story will probably appear early in 1991, to coincide with the spring opening.

CROSLEY DEFLECTRON TUBES

The Winter 1969 OTB (Vol. 8, No. 4, p. 7) describes an odd tube: the German Huth type PLAV-9 "Deflectron." The construction is unique since it appears to have a filament between two plates - no grid! No more thought was given to this oddity until AWA acquired six different versions of a similarly constructed tube bearing Crosley markings. They are as follows: (1) similar in size to the de Forest DV2; (2) similar in appearance to the DV20; (3) the same as the DV20 except 1/4" taller; (4) the same as the DV20 except 1/2" taller; (5) globular in appearance (like the UV-201) except with a blue glass envelope like an Arcturus product; (6) with a plain brass base and similar to the DV2, but not "gettered" or "flashed," enabling one to see the odd double-plate construction.

The first five are heavily gettered, with plated bases, ceramic fill, short pins (UV-style), and are marked "Crosley Deflectron" nicely stamped into the circumference of the base.

We believe AWA has a set of rare prototypes. Few were made. Mike Feher reported he had had one but sold it many years ago. Are there other Deflectrons in members' collections?